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THE SMITHSONIAN INSTITUTION AND ITS AFFILIATED BUREAUS.

A LETTER from Professor Franz Boas concerning the Bureau of American Ethnology, published in this issue of SCIENCE, calls attention anew to the unsatisfactory status of the bureaus of the Government under the supervision of the Smithsonian Institution. The anomalous relations which the National Museum has long sustained to the Smithsonian Institution were considered at length in SCIENCE, N. S., Vol. V., No. 106, January 8, 1897. The conclusions reached in that number of the journal are summed up in the following paragraph:

"There is no logical connection between the Smithsonian Institution and the National Museum. The museum is a most important institution; it is now well established; its maintenance is demanded by the people, and it will thrive under a competent director, responsible only to Congress or to the head of some department under which it could properly be placed. The usefulness of the Smithsonian Institution will be increased by the diminution of burdensome administrative duties which were never contemplated in its original

scheme, and for the existence of which there can be no reasonable excuse. Its legitimate work is too important to be interfered with by demands which can be met in ordinary channels, and if such wide departures from its early policy continue to be forced upon it by ill-considered legislation, there is reason to fear that its splendid career during its first half century will not be repeated in the second."

Subsequent events have not only justified these conclusions, but they now appear to be emphasized to an unexpected degree by the action of the Secretary of the Smithsonian Institution with regard to the Bureau of American Ethnology. This organization, like the National Museum, originated in the Smithsonian Institution, and, as in the case of the museum, has long been maintained by annual appropriations from the Government. It has performed an invaluable service to science in preserving the natural history of the rapidly vanishing native races of this continent and has given promise of development into one of the most important branches of public service. Naturally, like the National Museum, the Bureau of Ethnology has come to occupy a definite field of its own and has grown quite beyond the need of the fostering care of the Smithsonian Institution. During Major Powell's directorship of the bureau it attained a quasi-independent status in spite of the obviously bad plan of a double-headed administration, by which the director of the bureau was responsible to the Secretary of the Smithsonian Institution and the Secretary to the Government.

But now it would appear that the Secretary of the Smithsonian Institution has decided to relegate the Bureau of Ethnology to the subordinate position of a branch of the museum. If this be the case, and it seems impossible to interpret the recent action of the secretary in any other way, we can not help regarding the step thus taken as a step backward. For the bureau has not only done work which has commended itself to the Congress of the United States, but it has done work which has commended itself in a high degree to the consensus of opinion of expert ethnologists and anthropologists at home and abroad. Since the reasons for the Secretary's procedure in this case are not evident, a prompt investigation by Congress and by the regents of the Smithsonian Institution would seem to be called for.

There is another aspect of this matter which demands criticism. Quite apart from the particular personalities involved, it would appear that the Secretary has registered a blow with scientific precision directly at the merit system by appointing as 'Chief' of the bureau another man instead of the Ethnologist in Charge, whose position, abilities and record for effective work in the bureau led most anthropologists and ethnologists of the country to expect him to succeed Major Powell in the directorship. Such blows have been struck commonly enough, as every one knows, in the past, by political secretaries of the various departments of the Government, but they have rarely come from distinguished men of science. Those who would like to keep prominent positions in the govern-

ment scientific bureaus open for raids from politicians and opportunists will make effective use, doubtless, of this latest precedent in their favor.

But what, it will be asked, is the remedy for such blunders in the administration of government scientific work? Have we nothing better to suggest than destructive criticism? The remedy in the present instance is plain. The Bureau of American Ethnology should be put on an independent footing; that is, it should be directly responsible to Congress for the conduct of its work; and the National Museum should speedily go the same way. During the first half century of its existence the Smithsonian Institution rendered the highest service to American science and to the public weal by assisting in the development of—perhaps one might justly say by originating and developing—the Weather Bureau, the Geological Survey and the Fish Commission; and its influence was hardly less potent in promoting the scientific work of the Naval Observatory and the Coast and Geodetic Survey. As soon, however, as the merits of these organizations were recognized by the Government, it was the policy of the Smithsonian Institution to turn to other fields of work; and the verdict is unanimous that this policy was the wisest one to pursue by 'an establishment for the increase and diffusion of knowledge among men.'

The case under consideration raises also the question whether there is any way to improvement in the mode of selecting heads of the bureaus doing scientific work for the government. It appears that hitherto, as a rule, far less pains have been taken in choosing such heads than our scientific societies take in choosing a president or a secretary to represent them professionally and before the public. Indeed it has frequently happened in the past that men of no scientific standing, or of small professional reputation, have been placed in charge of important scientific work. But scientific men are largely responsible for this, for their silence has often given assent to corrupt practices and to unworthy appointments in the public service. It is a duty of scientific men and of scientific societies to look into these matters, and to see to it that science is not degraded by the pretenders who always stand ready to make a personal use of the prestige won by the industry and the persistence of the eminent. It is especially the duty of scientific societies to make their influence felt in all such matters. They may not always be able to give the best advice, but they are much more likely to give good advice than place seekers and appointing officers. The standard for appointment to prominent positions in government scientific work should be higher than that in any other branch of the public service. To obtain this end our societies can do much if they so will. No man of science can now afford to ignore the advice they are able to give on important questions of public moment; and the time ought to arrive presently when their counsel on all such questions will be welcomed and appreciated by society at large.

THE HUXLEY LECTURE ON RECENT STUDIES OF IMMUNITY, WITH SPECIAL REFERENCE TO THEIR BEARING ON PATHOLOGY.*

Gentlemen,—You will readily believe that with my deep appreciation of the high honor conferred by the invitation to deliver the fourth Huxley lecture there was joined a sense of great embarrassment in being called upon to follow in this office three such leaders of world-wide fame as Sir Michael Foster, Professor Virchow and Lord Lister. But the letter of the Committee of the Charing Cross Hospital Medical School stated that the choice of a successor to these great names was 'a tribute of our admiration for the great army of scientific workers on the other side of the Atlantic.' While I cannot assume to occupy any other place in this army than that of a soldier in the ranks, I felt that if my acceptance of this invitation could be regarded as in any sense an expression of appreciation by American workers in science of the commendation and good-will of our British colleagues, of our large indebtednesss to them, of our sense of the common interests, the comradeship and the kinship of the English-speaking peoples on both sides of the ocean, I should not decline, even if summoned to occupy a position of danger.

There was another consideration which I may be permitted here to mention. Through Huxley there is, if not a bond, at least a link, between the Charing Cross Hospital Medical School and the Johns Hopkins University. This lectureship was founded to commemorate the fact that Huxley received his entire medical education at the Charing Cross Hospital Medical School. While throughout America the name of Huxley is held in high honor as that of a great discoverer and interpreter in science, and while the influence which he has exerted upon popular as well as scientific opinion through those messages peculiarly fitted to the needs of English thought is not less there than among his own countrymen, we at the Johns Hopkins University have special reasons to acknowledge our gratitude to him. He crossed the ocean to deliver the principal address at the opening of this University in 1876, and he then gave utterance to ideas concerning university, and especially medical, education which were at the time and have remained an inspiration and a guide to us. Then, too, the Johns Hopkins University owes to Huxley and to Michael Foster the accession to its faculty of my lamented colleague, Newell Martin, who by the introduction and development of the biological methods and conceptions of his teachers gave such new directions and so great an impulse to biological study in America that his own work and that of his pupils started for us a new era in this department.

The first Huxley lecturer has made it unnecessary for his successors to dwell upon Huxley's studentship at the Charing Cross Hospital, upon the important influence which this had upon his career, or upon his great services to medical science, although his chief title to fame lies outside of the domain of medicine. I should like, however, to quote a passage, although it must be familiar to you, from Mr. Leonard Huxley's charming 'Life and Letters' of his father, which has appeared since the date of Sir Michael Foster's lecture, for it shows that 'it was at Charing Cross Hospital where Huxley first felt the influence of daily intercourse with a really able teacher.' He says:

> No doubt it was very largely my own fault, but the only instruction from which I obtained the proper effect of education was that which I received from Mr. Wharton Jones, who was the lecturer on physiology at the Charing Cross School of Medicine. The extent and precision of his

* Delivered at the opening of the winter session of Charing Cross Hospital Medical School, on October 1, 1902.

knowledge impressed me greatly, and the severe exactness of his method of lecturing was quite to my taste. I do not know that I have ever felt so much respect for anybody as a teacher before or since.

Wharton Jones, who will doubtless be longest remembered as the discoverer of the amœboid movements of the white blood corpuscles, was an experimental physiologist and pathologist of much originality, and it seems to me that there has not been, even in his own country, so full a recognition of his work as its importance merits.

Before passing to the special theme of this lecture it is fitting that I should pause, if only for a moment, to call to mind with affection and reverence that recently departed great man who honored and delighted you four years ago, and who has conferred such high distinction upon the office of Huxley lecturer. When one considers the full import of the discovery and establishment by Virchow of the principles of cellular pathology, that this constitutes the secure foundation upon which nearly two generations have built and future generations will continue to build the edifice of scientific medicine, I do not know what greater name there is in the whole history of medicine than that of Rudolf Virchow. How noble his character! With what amazing industry, versatility and keenness of intellect did he fruitfully cultivate the new fields which he had opened to research as well as other departments of science! With what devotion and beneficial results did he give his time and abundant knowledge to the service of the public and of our profession! We mourn the loss of a hero of medicine and of science, a benefactor of his race, and we rejoice in the rich fruitage of a long and well-spent life.

The first place in experimental medicine to-day is occupied by the problems of immunity, and, in accordance with the trust of the Huxley lectureship, which provides that the lecture shall relate to 'recent advances in science, and their bearing upon medicine and surgery,' I have chosen for my theme 'Recent Studies of Immunity, with Special Reference to their Bearing on Pathology.' As it would be hopeless to attempt a complete review of this broad subject within the space of a single lecture, I shall dwell more particularly upon certain of its aspects, not always of necessity the most important ones, which I conceive to be less familiar to most physicians, or which have engaged my attention, although much which I shall say is of course known to those who have followed the results of recent work in these new lines of investigation.

Under 'studies of immunity' I have included, as a matter of convenience, though not with strict accuracy, investigations which, although the direct outgrowth of those primarily directed toward a solution of the problems of immunity, have extended far beyond these bounds, and have revealed specific properties of cells and fluids in health and in disease of the broadest biological interest. We find illustrated here the familiar fact, nowhere more important to recognize than in medicine, that the sciences are interdependent, that discovery in one field sheds light in most diverse and often unexpected directions, and opens new paths to research. We shall see also exemplified the fructifying influence upon the advancement of knowledge of the discovery and application of new methods of investigation.

In endeavoring to follow in its intimate workings the contest of the living body with its invaders, the attention of investigators has naturally been drawn both to the action of the cells and to the properties of the fluids of the body in this struggle, to the latter sometimes without sufficient

consideration of the dependence of the humors in their composition upon the cells. Each of these lines of study, whether followed separately or conjointly, has led to the discovery of important facts relating to the mechanism of immunity.

We owe to Metchnikoff and his pupils the most important observations concerning the direct participation of leucocytes and other cells in the processes of infection and the production of immunity. Whatever attitude one may take toward Metchnikoff's well-known phagocytic theory of immunity, one must recognize the wealth of new facts which he has brought to light, and must admire the skill and fertility of resource with which for two decades he has defended this theory against severe assaults, and he has done so, in my judgment, with a large measure of success. With wonderful ingenuity in his recent book on immunity he rescues the phagocytes and applies to a deeper insight into their activities results of his opponents' work.

The other line of research, in some respects more important, was opened by Nuttall in 1888, working in Flügge's laboratory, by his systematic study of the antibacterial properties of the body fluids, particularly of the blood serum. It is true that there were previous indications of the power of fresh blood to kill bacteria; indeed, if one wishes to trace this matter historically to its roots he must go back to John Hunter, who was quite familiar with the antiputrefactive power of fresh blood, although of course he knew nothing of bacteria. Hunter showed that putrefying fluid could be added in small quantity to fresh blood without setting up putrefaction; and in elaborating his favorite doctrine of the 'living principle of the blood' he interested himself greatly in certain phenomena which, interpreted in the light of our present knowledge, are clear anticipations of some recent findings.

After Nuttall our knowledge of the bactericidal power of the blood serum was extended by Buchner and others; but the next advance of fundamental importance in this direction was Pfeiffer's discovery in 1894 of the quick extracellular disintegration and solution of cholera spirilla in the peritoneal cavity of immunized guinea-pigs or in that of normal guinea-pigs treated with immune serum, and of the presence in the immune serum of a specific substance concerned in the bacteriolytic process although by itself without bactericidal power.

In the meantime Behring had made his great discovery of antitoxic immunity and of the protective and curative value of antitoxic serum, and Ehrlich had done much to elucidate the nature of this form of immunity. It soon became apparent, however, that immunity from the great majority of bacterial infections does not depend in the main upon the antitoxic principle. The attention of bacteriologists, therefore, was drawn more and more to the so-called 'Pfeiffer phenomenon,' which was found to be of great general significance; and starting from this, and especially from the investigation of the analogous and much more readily studied solution of red corpuscles by foreign serum, there has followed in rapid succession up to the present time a series of new and most interesting discoveries and conceptions with which are connected many names, but most prominently those of Metchnikoff and Bordet, and of Ehrlich and Morgenroth.

Through these various studies of immunity we have become acquainted with an important physiological capacity of the healthy organism, the extent, and in most instances the existence, of which was unsuspected until quite recent years. This capacity is the power to produce substances specifically antagonistic to all sorts of foreign cells and cellular products and de-

rivatives. The substances capable of inducing this immunizing reaction appear to be mainly of an assimilable, albuminous nature, or at least intimately associated with such material, although it has been proved that certain non-albuminous derivatives of proteids have the same power.* The mode of antagonism of the specific bodies formed in response to the reception within the living organism of substances capable of inducing the necessary reaction varies with the nature of these latter substances, and consists in such diverse manifestations as neutralization of poisons and of ferments, injury or destruction of cells, associated with characteristic morphological changes, cessation of motility of cells or their appendages, agglutination of cells, precipitation, and coagulation. In accordance with these different effects, the corresponding antagonistic bodies, or antibodies, as they are called, are classified as antitoxins, antienzymes, cytotoxins, agglutinins, precipitins and coagulins, and even against these bodies, with the exception of the antitoxins, antagonists have in turn been produced. All of these bodies are in varying, but usually high, degree specific with reference both to the nature and to the source of the material upon which they exert their characteristic effects.

The cytotoxins or cytolysins include not only the bacteriolysins and hæmolysins, but also a great number of other cellular toxins present in the sera of animals which have received injections of cells from a different species. To every cellular group of an animal species there appears to correspond a specific cytotoxin. To designate these various cytotoxins such self-explanatory names as leucotoxin, spermotoxin, nephrotoxin, neurotoxin, thyreotoxin, syncytiotoxin are used. Their specificity extends not only to the nature of the cells, but also to the species of animal furnishing the cells used for their production.

One of the most important results of recent work is the separation of these specific antibodies into two groups, in one of which, represented by the antitoxins, the antagonists are single bodies; while in the other, represented by the cytolysins, the antagonistic effect requires the cooperation of two bodies. Of these two bodies the one which actually destroys the foreign cells, or induces other specific effect, is normally present in the cells or fluids of the organism, but it seems incapable of action without the intermediation of a body which is distinguished from it by greater resistance to heat, and which is produced by the immunizing reaction, although it may also be normally present in smaller amount.* The two elements composing a cytolysin exist quite independently of each other, so that one may be present without the other, or be artificially removed without affecting the other. Of the multitude of names proposed for these cytolytic components those most commonly used for the body which is the specific product of immunization, although it may also exist normally,

* Specific precipitins have been produced by injection of crystalline and other so-called pure proteids. Obermayer and Pick produced immune bodies by the use of non-albuminous products of tryptic digestion of certain albumins. Jacoby has shown that the specific body concerned in ricin immunization is non-albuminous. A. Klein obtained entirely negative results with injections of starch, glycogen, glucose, gum arabic and gelatine.

* Metchnikoff believes that the complement or cytase, which in his opinion exists under normal conditions solely within cells, not free in the plasma, acts in natural immunity without the cooperation of an intermediary body or fixative, the latter being concerned only in acquired or artificial immunity. The evidence seems, however, to favor the view that in this regard the conditions are similar in both forms of immunity, the main difference being the presence of a much larger amount of the specific immune body in the latter.

are intermediary body, immune body, amboceptor, sensitizer, fixative, preparative, desmon, and for the other body complement, alexin, cytase. It is this latter body which contains the atomic group described as toxophoric or zymophoric.

Concerning the source, mode of action and constitution of the specific antagonistic bodies we are very imperfectly informed. That they are of cellular origin seems certain, and Ehrlich with great ingenuity, on the basis of a brilliant series of experiments, has advanced a hypothesis regarding them which, in my opinion, better than any other hitherto suggested, accords with the known facts, and in promoting discovery has already done the greatest service of which a working hypothesis is capable. Ehrlich has so recently and so fully in the Croonian lecture presented before English readers his hypothesis of the side chains or receptors and the basis for it, that I need only recall to your minds his conception that the toxins, cells and other substances which lead within the living body to the production of antitoxins, cytolysins and other antagonists have this capacity only through the possession of specific affinities, called haptophore groups, for corresponding haptophore groups belonging to side chains or receptors of certain cellular constituents of the body, and that in consequence of this appropriation of receptors, others of like nature are reproduced in excess of the needs of the cell, and these being shed into the lymph and blood, there constitute the antitoxins, intermediary bodies, agglutinins and other specific antagonists. The antitoxic receptor has only a single combining affinity, which is for the toxin, whereas the cast-off receptors constituting the intermediary bodies of cytolysins have at least two affinities (hence called amboceptors by Ehrlich), one of a more highly specialized nature being for the invading bacteria or other foreign cells, and the other for the complement.* The antibody enters quantitatively into definite chemical union with its affinitive substance. The essence of Ehrlich's theory concerning antitoxin is thus tersely expressed by Behring: 'The same substance which, when incorporated in the cells of the living body, is the prerequisite and condition for an intoxication becomes the means of cure when it exists in the circulating blood.' So of the twofold bactericidal and cytolytic agents we may say that the living body possesses substances which may protect it by destruction of invaders or may injure it by destruction of its own cells, according to the mates with which these substances are joined.

An inquiry which naturally arises in this connection is: What is the physiological mechanism called into action in the processes resulting in the production of antitoxins, cytolysins and similar bodies? We have no reason to suppose that the animal body is endowed with properties specially designed to meet pathological emergencies. Its sole weapons of defense, often lamentably imperfect for morbid states, are

* According to Ehrlich's latest conception, resulting from investigations to demonstrate the multiplicity of complements, an amboceptor has a single cytophilic affinity, and a number of complementophilic affinities differing in their avidity for various complements. He regards the agglutinins, precipitins and coagulins as uniceptors of more complex structure than the antitoxins, but Bail has recently brought evidence to show that agglutinins, like cytolysins, are composed of two elements. For the purposes of this lecture, it is not deemed necessary to enter into these or many other details of this complicated subject. For comprehensive and admirable critical reviews of recent theories of immunity and Ehrlich's hypothesis of the receptors, I would refer to Dr. Ritchie's papers in the *Journal of Hygiene*, Vol. II., No. 2, and succeeding numbers; and to Dr. Aschoff's paper in *Zeitschrift f. allgem. Physiologie*, Bd. III., Heft 3.

adapted primarily to physiological uses.* To the foregoing inquiry Ehrlich answers that the mechanism concerned is one physiologically employed for the assimilation by the cells of food. The receptors are in the cells, not for the purpose of linking poisons to the cells but to seize certain food stuffs, particularly the proteids, and the toxins and bacterial and other foreign cellular substances, if capable of inducing the immunizing reaction, chance to have the requisite combining affinities for the food receptors. It is interesting that Metchnikoff also, though from a different point of view, refers the mechanism of immunity to the physiological function of assimilation of food by the cells.

Inasmuch as, according to Ehrlich's hypothesis, the specific antagonistic substances resulting from the injection of toxins and of foreign cells or derivatives of cells exist preformed in cells of the normal body, there would appear to be no reason why any one of them might not occasionally be present normally free in the blood or other fluids. In fact, many of them—such as diphtheria and tetanus antitoxins, various antienzymes, bactericidal, hæmolytic and other cellular toxins, agglutinins and a number of other bodies of this class, as well as their antibodies—have been found repeatedly, though of course in the case of many inconstantly and with marked differences between individuals and species, in the blood of healthy human beings or animals when their presence could not reasonably be attributed to a previous specific immunization. Of these normal antibodies the only one which is increased in amount by the process of immunization is that specifically related to the material used to bring about the reaction. As already stated, it is the intermediary body,* not the complement, which is generated in immunization against bacteria and other cells.

The foregoing statements, though of necessity condensed and incomplete, about the general characters of the specific antibodies will, I trust, help to a better understanding of what is to follow concerning the bearing of some of these discoveries on medical science and practice. I realize the difficulties which you must already have experienced, if unfamiliar with these new lines of research, in following a brief presentation of a subject in which not only are the facts so complex, and the ideas so novel, but the terminology so strange and burdened with such a multitude of confusing synonyms. While deploring the multiplication of unnecessary new terms, I should like to quote in this connection a wise remark of Huxley:†

"If we find that the ascertainment of the order of nature is facilitated by using one terminology, or one set of symbols, rather than another, it is our clear duty to use the former; and no harm can accrue so long as we bear in mind that we are dealing merely with terms and symbols."

The most remarkable and characteristic attribute of these antibodies is the specificity of their relation to the substances which have led to their formation. Of some of them, such as diphtheria or tetanus antitoxin, this specificity is nearly absolute; of other, such as the precipitins, it is only relative. This property is the basis of new and most valuable methods for the identification of species and the determination of genetic relations—species not only of living

* W. H. Welch, 'Adaptation in Pathological Processes,' *Trans. Congress American Physicians and Surgeons*, 1897, Vol. IV.

* I use in this lecture the name 'intermediary body' in preference to the more technical term 'amboceptor,' although Ehrlich applies the German equivalent—*Zwischenkörper*—only to normal as distinguished from immune amboceptors.

† Huxley, 'On the Physical Basis of Life,' 'Collected Essays,' Vol. I., p. 164, New York, 1893.

things, but also of chemical substances and of disease.

The resemblances and the differences thus revealed are doubtless fundamentally of a physico-chemical nature, but in many instances they transcend the powers of the microscope or of ordinary chemical tests to detect.

The results already attained by the method of serum diagnosis*—using this expression in its widest sense—are not only of interest and importance to the biologist, physiologist and chemist, but of great practical value to the bacteriologist and the physician. As this is not an aspect of my subject, broad and important as it is, upon the details of which I propose to dwell, it must suffice to present, by way of illustration, examples of the diagnostic application of different kinds of specific serums.

The only certain means of detecting toxins of the class of diphtheria or tetanus toxin, snake venom and certain vegetable poisons of the same category is their neutralization by the corresponding antitoxic serums. Occasion may arise where such detection is of practical and even medico-legal importance, as has been exemplified in India, where the criminal use of cobra venom is not unknown.

* The general procedure followed in the production of specific serums is the injection into a suitable animal at intervals of time repeated doses of toxins, bacteria, foreign cells, or other material against which the antibody is desired. For example, if a specific precipitating or a hæmolytic serum for human blood is wanted, an animal, say a rabbit, is injected subcutaneously or intraperitoneally at intervals of three or more days with five or six doses of human serum or human red blood corpuscles. At the end of this time the rabbit's serum has acquired the property of precipitating human serum in strong dilutions, or of dissolving human red blood corpuscles, if these were used for the injection. Within limits the less closely related the two species of animals the more powerful is the antagonistic effect of the specific serum. This is true especially in the case of cytotoxic serums.

The application of serum diagnosis which is most familiar to physicians is the agglutinative test for typhoid fever. The principles of the agglutinative reaction were worked out in the laboratory of Professor Gruber in Vienna by himself and Durham, and were there first applied to the diagnosis of typhoid fever by Grünbaum, who was anticipated in his publication by Widal, who has made a thorough clinical study of the subject. The method is of great value, not only in the diagnosis of disease, but also in the identification of bacterial species and the recognition of relationships between species. Durham, to whom we owe important contributions to this subject, has given an ingenious hypothetical explanation of mutual agglutinative reactions, the main features of which are paralleled in Ehrlich and Morgenroth's doctrine, based upon experiments, relating to the multiplicity of cell receptors and of amboceptors concerned in hæmolysis.*

We have found the agglutinative reaction an indispensable aid in the study of the series of cases of paratyphoid fever which have come under observation in Dr. Osler's wards at the Johns Hopkins Hospital, and which otherwise it would have been scarcely possible to have separated from typhoid fever.† The occurrence of paratyphoid fever as a distinct disease affords an explanation of a certain proportion of the failures of the serum from supposed typhoid fever patients to clump typhoid bacilli. Not less valuable is the serum test in the diagnosis of *Bacillus dysenteriæ* Shiga and of the diseases caused by it. This microorganism has been shown by Flexner and his pupils, Vedder and Duval,

* Durham, *Journal of Experimental Medicine*, January 15, 1901, Vol. V., p. 353. Ehrlich and Morgenroth, *Berl. klin. Woch.*, May 27, 1901, p. 570.

† See papers on paratyphoid fever, by Johnston, Hewlett and Longcope in *American Journal of Medical Sciences*, August, 1902.

to be the cause of our acute dysenteries, and recently in Baltimore Duval and Basset, working with the aid of the Rockefeller Institute for Medical Research at the Thomas Wilson Sanitarium for Children, have discovered that this same bacillus is in all probability the specific agent of infection in the summer diarrhœas of infants.

Bacteriolytic serums have been used by Pfeiffer in the differentiation of cholera and allied spirilla, but few other bacteria present equally well the Pfeiffer reaction, which is not nearly so useful or handy a means of identification as the Gruber-Durham reaction.

Of other cytolytic serums the hæmolysins have been by far the most carefully studied. One of the most interesting results of this study has been the determination by precise quantitative methods of resemblances and of differences between red blood corpuscles which in no other way could be distinguished. These resemblances and differences relate to the red corpuscles not only of different species of animals, but also to those of individuals of the same species. Although we constantly assume the existence of cellular differences between individuals and between species, these are for the most part of so subtile a nature as to elude our methods of observation. The exact demonstration of such differences by the use of cytolytic serums is therefore of especial interest. My assistant, Dr. H. T. Marshall, in an unpublished research, conducted under the direction of Professor Ehrlich and Dr. Morgenroth, upon the receptors of the red blood corpuscles of man and of two species of monkey, found that while man and the monkeys each have receptors not shared by the other, they also have a large number of receptors in common.

This result is in harmony with Nuttall's interesting observations on a much more extended scale regarding phylogenetic relationships between animal species, as shown by the reaction of their blood with the specific precipitins discovered by Tchistowitch and Bordet, and introduced into practical medicine by Wassermann. This biological test to determine the source of blood, when used with proper precautions, far surpasses in accuracy all other methods for this end. While it would lead too far from my purpose to follow this subject farther, I cannot in this connection forbear at least mentioning one of the earliest and most suggestive papers on this class of antibodies—that 'On Immunity against Proteids,' by Walter Myers, who gave up his life in the cause of science and of humanity, and whose early death is so great a loss to English medical science.

I shall ask your attention now to some considerations concerning the bearing of recent studies of immunity on the nature and action of toxins. This subject is, of course, of the greatest pathological as well as bacteriological importance, and I believe a closer cooperation than now exists between bacteriologists and pathologists in its study would further the surer and more rapid advancement of our knowledge about it. One misses only too often in purely bacteriological papers on this subject exact knowledge and descriptions of pathological conditions, and, on the other hand, pathologists often fail to utilize pertinent facts and ideas which are familiar to bacteriologists.

The discovery by Roux and Yersin of the diphtheria toxin, the studies by Behring and Kitasato of tetanus toxin leading up to Behring's epochal discovery of antitoxin, and the later investigations of Ehrlich on the constitution of diphtheria toxin and the origin and mode of action of antitoxin are the great events in the most brilliant and securely founded chapter of modern studies of immunity. Through these

researches we became acquainted with a class of poisons secreted by certain bacteria, and present in solution in culture fluids. The evidence is conclusive that these soluble toxins enter, as assimilable substances, into direct combination with constituents of the body cells for which they have an affinity, and only thereby are enabled to bring about immunity or to exert toxic effects. As shown by the modifications of toxins called toxoids, the toxic property may be destroyed without loss of the combining power, and without removal of the immunizing power. According to Ehrlich's helpful conception, based on a large amount of experimental evidence, and now very generally accepted, the combining power of the toxin molecule resides in a group of atoms, designated as the haptophore group, with affinity for the corresponding haptophore groups of the side chains or receptors of cellular constituents, and the toxic power pertains to another and less stable atom complex in the molecule.

By means of these facts, and legitimate deductions from them, we are enabled to explain in a satisfactory way susceptibility to poisoning by these soluble toxins, their selective action upon the cells of the body, and their quick disappearance after injection into the circulating blood. In one infectious disease and in one only, to wit tetanus, are we able to explain the clinical and pathological phenomena in minute detail on the basis of our knowledge of the causative microorganism and its poisonous products. The nearest approach to this instance is diphtheria, but here we have not yet been able to follow the trail of the toxins within the body so perfectly, and, as Flexner and I have shown, in addition to the soluble toxins there is an intracellular poison concerned in the production of the false membrane. Interesting investigations, which have greatly helped to elucidate the nature of these toxins, have been made on various similar vegetable and animal poisons, such as ricin and abrin from the former source and the venom of snakes, spiders and other poisonous animals.

The high hopes which were raised by the discovery of the soluble bacterial toxins that at last the way was opened for us to penetrate into the mysteries of the mode of action of pathogenic bacteria were soon doomed to disappointment, for similar powerful toxins, though diligently sought, could not be detected in the cultures of most other bacteria, and these among the most important ones, such as the tubercle bacillus, the typhoid bacillus, the cholera spirillum, the pneumococcus, the pyogenic micrococci. This disappointment was all the more acute because there was and is every ground for confidence that whenever we have in our possession a powerful toxin of this class, a strong protective antitoxic serum can readily be obtained.

Notwithstanding these negative results, the belief was not abandoned that bacteria harm the body mainly by poisoning, for it rests upon strong clinical and pathological evidence, as well as upon the study of the distribution of bacteria in the infected body. The search for poisons was turned from the fluid part of cultures to the bacteria themselves, and thus Pfeiffer succeeded in demonstrating as an integral constituent of the bodies of cholera spirilla toxic substances, which are liberated only when the bacteria degenerate or die. Intracellular poisons, which indeed previously, though of a different nature, had been extracted from bacteria by Buchner and by Koch, were subsequently found within typhoid bacilli and a number of other pathogenic bacteria.

It is of more than purely bacteriological interest to recognize the distinction between the small group of pathogenic bac-

teria, represented by the bacilli of tetanus, of diphtheria, and of botulism, characterized by the secretion of powerful soluble toxins, and the much larger group, containing most of the other pathogenic bacteria, which do not secrete similar strong toxins, for it is only the former which give rise to the production of antitoxic serum of marked protective and curative power.

The form of immunity resulting from injections or natural infections with the second class of bacteria belongs mainly to the bacteriolytic type, in which the complete antibody is not a single substance, like antitoxin, but is composed of two distinct elements, intermediary body and complement, of which only the former is produced or increased in the process of immunization. The bacteriolytic serums are also under suitable, but not readily controlled conditions, protective and curative, but owing, it would seem, mainly to the duplex nature of the antibody their successful therapeutic application meets difficulties which have not yet been overcome. The great practical problem of bacteriology to-day is to make available to medical practice the bacteriolytic serums such as antityphoid, antipneumococcus, antistreptococcus, antiplague, antidysentery serums. Such work as that of Marmorek, of Wassermann, of Neisser and Wechsberg, of Ainley Walker, upon the production, the properties, the conditions underlying the action of these serums is, therefore, highly important.

Our knowledge of the constitution and action of the intracellular bacterial poisons is most incomplete and at present cannot be applied in any very definite and satisfactory way to the explanation of the morbid phenomena of infectious diseases. Such investigations as those undertaken by Macfadyen and Rowland at the Jenner Institute of Preventive Medicine upon the expressed juices of bacterial cells promise to shed light upon this subject and in general upon the vital processes of bacteria. Of great value also are the recent researches of Vaughan upon intracellular bacterial poisons.

I find it difficult to reconcile myself to the doctrine that bacteria, such as the typhoid bacillus, the pneumococcus, and others of the class now under consideration, do their chief injury to the body, not while they are lively and vigorous, but after they become corpses and in consequence set free their protoplasmic poisons. Still this latter conception is the basis of a coherent hypothesis of infection, elaborated most fully recently by Radziewsky,* which rests upon a considerable amount of accurate observation and interesting experimental work. There can be no doubt that in the course of many infections there goes on an enormous destruction of the bacteria concerned so that the numbers of those indicated at any given time by microscopical examination and by cultures may represent only an insignificant fraction of the total progeny of the first invaders. I have been much interested in this phenomenon, since I became familiar with it over twelve years ago† in pneumococcus infections through the employment of a method which revealed in the exudates degenerating and dead pneumococci and their empty capsules in numbers often far exceeding the intact organisms; indeed, in some cases so many that they formed a large part of the exudate.

While all due weight should be given to such facts as these, the objections to the acceptance of the hypothesis just mentioned

* Radziewsky, *Zeitschrift für Hygiene*, 1900, XXXIV., p. 185, and 1901, XXXVII., p. 1.

† Welch, *Bulletin of the Johns Hopkins Hospital*, July, 1890, and December, 1892. Michaelis, *Berl. klin. Woch.*, 1902, No. 20, has recently reported the same findings.

as affording a complete explanation of the toxic phenomena of this class of infections are so obvious that naturally efforts have been made to learn whether bacteria which produce no strong soluble toxins in our ordinary culture media may not do so on other media of special composition or in a demonstrable way within the living body. Work in these two directions has not been altogether barren, as shown by results of experiments made by Hueppe, Cartwright Wood, Marmorek, and others along the former lines, and by Metchnikoff, Roux and Salimbeni along the latter, but it cannot be said that these experiments have led to any generally accepted solution of the main difficulties. Some are therefore inclined to lay the chief emphasis upon disordered cellular metabolism, but this is only a restatement of the question. Everybody recognizes abnormal metabolism as an essential condition in infections. The very point needing explanation is how the bacteria derange metabolism.

I wish here to advance a hypothesis which seems competent to explain the source, the mode of production and the nature of certain bacterial toxins. It would appear to be a natural inference from the receptor theory of Ehrlich and the recent work on cytotoxins. The following considerations will, I hope, make clear the essential points.

As I have already stated, we know that the injection of foreign cells, such as pathogenic bacteria, red blood corpuscles, spermatozoa, epithelium, into the tissues of a living animal leads to the formation of poisons, called cytotoxins, acting specifically upon these cells; that the substances which stimulate the cells of the host to produce one constituent of this class of toxins consist of certain atom complexes derived from the injected cells; that certain cells of the host thus stimulated generate and discharge one component of the toxin, called the intermediary body, which, although by itself not poisonous, becomes the medium of intoxication through union, on the one hand, with a preexistent toxophore substance, called the complement, and, on the other hand, with the foreign cell which started the reaction.

Such is the response on the part of the host to the entrance of the foreign cells; but how about a possible response of a like nature on the part of the invading cells toward the host resulting in the production of special cytotoxins, of analogous constitution, injurious to the host? This latter response, being of a vital nature, can take place only when the invading cells are living, as in the case of bacteria and other parasites.

I see no reason why suitable substances derived from the host may not stimulate parasitic organisms, through a physiological mechanism similar to that operative in the development of cytolytic immunity, to the production of intermediary bodies which, if provided with the requisite affinities, have the power to link complements to cellular constituents of the host, and thereby to poison the latter. Expressed in terms of Ehrlich's side-chain theory, certain substances of the host of cellular origin, assimilable by the parasites through the possession of haptophore groups with the proper affinities, become anchored to receptors of the parasitic cell, which, if not too much damaged, is thereby stimulated to the over-production of like receptors; these excessive receptors of the parasite, if cast off into the fluids or the cells of the host, there constitute intermediary bodies or amboceptors with special affinities for those cellular constituents or derivatives of the host which led to their production, and for others which possess in whole or in part identical receptors. Provided the host is supplied also with the appropriate complements, there result cyto-

toxins with special affinities for certain definite cells or substances of cellular origin in the host. The contribution of the parasitic cells to these cytotoxins is the amboceptors. Either the parasite or the host may provide the complements.*

It may perhaps aid in grasping the ideas here presented to imagine the bacterium, in the capacity of the host, as a structure so large that one could inject into it animal cells. Provided the proper receptor apparatus is present, the resulting reaction on the part of the bacterium, as described, would be a process of immunization against the animal cells through the formation of specific cellulicidal substances. In reality it is only certain atomic complexes of cells which are concerned in this immunizing reaction, and in comparison with these even the smallest bacterium is a gigantic object.

Looked at from the point of view of the bacterium as well as from that of the animal host, according to the hypothesis advanced the struggle between the bacteria and the body cells in infections may be conceived as an immunizing contest in which each participant is stimulated by its opponent to the production of cytotoxins hostile to the other, and thereby endeavors to make itself immune against its antagonists. These mutually antagonistic cytotoxins are capable of injuring the parasitic cells on the one hand or the body cells on the other, only when escaping combination outside of them they are anchored to the receptors of the cells to which their respective affinities are adjusted. This combination with the cells, if it does not result in too great injury to them, is the condition for further production of the cytotoxic intermediary bodies through over-production and discharge of receptors.* The im-

* We may thus speak of somatogenic cytotoxins resulting from the action of bacterial stimuli on cells of the host, and of bacteriogenic cytotoxins from somatogenic stimuli, also of somatogenic and bacteriogenic complements.

* It will be observed that these discharged receptors may be regarded as the equivalents of anti-immune bodies. E. W. Ainley Walker, in an interesting and suggestive paper on 'Immunization against Immune Serum' (*Journal of Pathology and Bacteriology*, March, 1902), shows experimentally that bacteria growing in immune serums produce anti-immune bodies, and thereby become more virulent. He concludes that 'the basis of bacterial virulence and of chemiotactic influence is identical, and constitutes that atom group which causes the production of the immune body.' My hypothesis includes the conceptions supported by Walker, and also much more. According to the hypothesis, certain bacterial antibodies are capable not only of neutralizing immune bodies of the host, but with the aid of complements also of poisoning the cells of the host. It is not difficult to imagine various conditions in which the anti-bodies of bacterial origin may escape neutralization before entering into union with the host's cells. The substances which stimulate bacteria to produce these antibodies need not necessarily be toxic to them; in fact, toxicity, such as that of strong bactericides of cellular origin, would hinder their production. The essential things are that the stimulating substances have the requisite combining groups for bacterial receptors, and that the cast-off receptors be complemented within the body of the host. Each of the various bacteriogenic cytotoxins probably contains a multitude of partial amboceptors, with varying cytophilic and complementophilic affinities, in accordance with the views of Ehrlich and Morgenroth. It is self-evident that through a mechanism similar to that described parasites within the infected body may be stimulated by atom groups derived from the host to the production also of antibodies other than cytotoxins, such as various agglutinins, precipitins, antienzymes, and perhaps of uniceptors of the nature of secreted soluble toxins, or of enzymes, all adjusted against the host. Questions relating to the source and nature of the complements, particularly of intracellular complements, and also to anticomplements, are manifestly of importance in relation to the hypothesis, but it would complicate the subject too much to discuss these and other matters here, where my purpose is merely to outline the essential features of this new theory of infection with reference to the particular points under consideration.

portant factors determining the issue of the contest are the qualities, the relative proportions and the distribution of the bacterial and the host's cytotoxins.

The hypothesis thus outlined can be tested experimentally, but I regret that it has shaped itself in my mind so recently that I have not yet been able to make the desired experiments, which are, however, now started in my laboratory. Since my arrival here I am informed that these experiments have already furnished facts in its support, which will be published later.

Inasmuch as at least one component, and it may be both components, of the assumed bacterial cytotoxins preexist in the bacterial cells, it should be possible to demonstrate some of them in artificial cultures of bacteria, where they would be found especially as integral parts of the cells, unless extracted from the bodies of degenerating or dead bacteria. This corresponds with what is known concerning the situation of the poisons of the cholera spirillum, the typhoid bacillus and other bacteria characterized by the lack of strong soluble toxins. But the quantitative and other relations between these cultural cytotoxins and those produced in the manner described by the same bacteria during processes of infection are comparable to those between the normal antibodies and the immune antibodies. These relations would explain the familiar fact that cultures of bacteria of the class under consideration constitute in general only a partial and meager index of the toxic capacities of the same bacteria in the infected body. That cytolysins may, however, be present normally in large amount is illustrated by the hæmolysins of eel's serum and of snake venom.

In this theory, degenerated and dead bacteria, while recognized as a source of poisoning in infections, are not assigned an exclusive rôle in this regard. Living bacteria in the infected body, where they are under nutritive conditions not paralleled in artificial cultures, actively produce and secrete receptors which may become the means of intoxication of the body cells. From what has been said, we can comprehend how these diverse free receptors may enter into the formation of cytotoxins of the most varied and specific characters, such as erythrotoxins, leukotoxins, neurotoxins, nephrotoxins, spermotoxins, hepatotoxins, etc. Very probably in many instances these toxins are represented by so few receptors in bacterial cells in ordinary cultures that it would be hopeless to search for them there, although we may have convincing experimental and pathological evidence that within the animal body the same bacteria produce them abundantly under the stimulus of appropriate substances derived from cells of the host.

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(To be concluded.)

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*THE LENGTH OF THE COLLEGE YEAR AND COURSE.**

A number of matters of general academic interest have occupied the attention of the university faculty, and to some extent that of the other faculties, during the year. The established policy of granting no honorary degrees was unanimously reaffirmed. The administration of the disciplinary authority of the university was devolved upon a committee consisting of the dean and four professors to be elected by the university faculty. The better conduct of examinations was much discussed; but owing to the difficulty experienced in discovering the sentiment of the students towards the so-called honor

* From the tenth annual report of President Schurman to the board of trustees of Cornell University.

system, no decision was reached, and the question is still unsettled. There is a strong sentiment both in the faculty and in the student body in favor of the honor system. No one wants to see watchers in examinations. But, under the honor system, no student wants to report cases of cribbing. Thus the cheater's honor in dishonor rooted stands. A system capable of administration must be devised, yet, if it is to be successful, it must be in harmony with the sentiments of the students.

At the suggestion of the American Association for the Advancement of Science, the Christmas vacation was extended so as to include the week in which the 1st of January falls, for the purpose of enabling members of the faculty to attend the meetings of the scientific and learned societies held at that time. This action is undoubtedly in the best interests of science and scholarship and highly advantageous to professors.

The lengthening of the Christmas recess suggests some observations on the amount of vacation now enjoyed by American universities and colleges. It is less, to be sure, than that which obtains in Great Britain. And from the point of view of professors, most of whom devote the summer vacation to investigation and writing, it is too short rather than too long. Furthermore, as it is by means of such self-regenerating studies that the professor maintains his efficiency as a teacher, a vacation so used is of inestimable advantage to the university. It is probably safe to say that the overwhelming majority of Cornell professors and instructors devote two thirds of their summer vacation to strenuous productive work, while others teach in the summer session or undertake special duties of a professional or technical character.

Nevertheless, the final cause of American colleges and universities is the student. His best interests must be the supreme consideration in determining the length of vacations. The Christmas recess being now fixed for the accommodation of scientists and scholars, and the spring recess being not much more than a week, it is worth inquiry whether, in the interest of students, the summer vacation should not be shortened. The Cornell summer vacation is about the average, possibly a little shorter. For the members of the instructing staff, as already observed, it is certainly not too long. Nor is it too long for students in law, medicine, engineering, agriculture, etc., who devote the summer months to work in offices, factories, or on farms, which supplements their theoretical studies and familiarizes them with the practical side of their callings. But for students in the academic department who have nothing in particular to do during the summer, the vacation is far too long. Why should young men from eighteen to twenty-two years of age be idle for three months simply because they are students for the other nine? Of course many students in the academic department do work—perhaps to earn money to procure an education—during the holidays, and at Cornell that class is probably larger than at any other great university in the east. But others are idle, as are also some of the students from the professional and technical departments; and for these the university should offer work. Yet, as has been shown, it is not to the interest of the university to demand too much teaching from its professors, else the spirit of research is quenched and the teacher becomes fossilized.

But these conflicting demands may be met by a summer session of the academic department (including allied technical subjects) with a faculty especially appointed for the purpose made up of Cor-

nell professors, if they desire the appointment, and professors of other universities selected for eminence in their respective branches of learning or science. The Cornell summer session, which continues six weeks, attracted this year more than twice as many regular students of the university (218 as against 101) as last year. And students in the academic department who regularly attend the summer session may, if they have entered on advanced standing or done extra work in course, satisfy the requirements for the A.B. degree in three years instead of four. This is a shortening of time without lowering the standards or even changing the character of the studies. In all discussions regarding the length of the A.B. course and the nature of the studies it should embrace, the summer session has been overlooked. Yet it may contain the key to that problem as well as to the problem of the adjustment of term time and holidays.

The relation of the A.B. course to the technical and professional courses has again been under consideration.

The faculty of arts and sciences some time ago made the work for the A.B. degree entirely elective. The tabulation by Dean Crane of the studies elected for four years by the class graduating in 1901, shows no wide divergence from the results formerly obtaining under the operation of the combined prescribed and elective system. Like the A.B.'s of preceding years, the graduates of 1901 selected courses predominantly humanistic. Of all choices of studies made by the class, 80 per cent. were in languages, philosophy, history and political science, and art. As compared with the prescribed classical course of a generation ago there is, however, a noticeable change. While 10 per cent. of the elections were in ancient languages, 37 per cent. were in modern languages, and 22 per cent. in history and political science. That is to say, while under the elective system the studies of candidates for the A.B. degree continue to be for the most part humanistic, the newer humanities—English, French, German, history, economics, etc.—have taken the larger portion of the place which a generation ago was occupied by the older humanities—Latin and Greek.

The privilege of students taking the A.B. course at Cornell to elect their own studies is not likely to be modified. Of course there are restrictions upon freshmen inherent in the nature of the studies themselves. And there is the further limitation, which critics continually ignore, that the subjects embraced by the academic department do not extend beyond the humanities and the pure sciences, so that a student entering upon the A.B. course is not permitted to elect work in engineering, agriculture or other technical or professional departments.

But, while the university refuses to reduce the A.B. course from four years to three, it does permit juniors and seniors who intend taking subsequently a professional course to anticipate one year of such work as a part of the A.B. course. The question has been raised whether, in such cases, the A.B. degree is given on the ground that the candidate has studied four years or that he has taken certain studies (arts and sciences) though for three years only. And the suggestion has been made that the subjects which juniors and seniors are permitted to take in the professional schools should be restricted to those which might be regarded as constituents of a liberal culture. But a university which allows its students to elect freely among languages, literature, philosophy, history, political science,, mathematics and the physical and biological sciences for the A.B. degree will meet great difficulty in applying the criterion suggested. Perhaps the best solution of the theoretical dilemma

which has been raised is to recognize frankly that the privilege of doing a year of professional work as a part of the A.B. course, which juniors and seniors now enjoy, is a favor extended to candidates who study at a university six or seven years, and that there is no reason for shortening the course of candidates whose studies cease on the receipt of the A.B. degree.

Another question, which has not indeed been formally discussed, but which has occasionally been mooted, is the advisability of requiring the A.B. degree (or its equivalent) for admission to the professional and technical courses. It seems safe to say that Cornell University is not likely soon to adopt that policy. If a youth desires to be a lawyer, engineer, physician or architect, there is no good reason why he should be compelled to study other subjects for four years as a condition of entering upon his professional course. And there is less reason to-day, when the A.B. course has everywhere been made largely, and in some institutions wholly, elective, than might have been imagined a generation ago when the prescribed classical course was deemed the one and indispensable means of liberal culture and mental training, which also fitted and qualified the candidate to undertake professional study. At Cornell University, at any rate, the established policy is to admit students to any course who are able to pass the examinations qualifying them to pursue that course. And such preliminary tests, it is generally conceded by the members of the professions concerned, do not exceed the requirements for graduation at the best high schools. The age of high school graduates is also suitable. And, finally, Cornell University could not, without surrendering the democratic spirit in which it was conceived and by which it has always been inspired, establish conditions of admission to its courses of study which would close its doors to the masses of the people and leave them open only to those who had time and money enough to study for a period of six or seven years after graduating at high schools. Nevertheless, the members of the professional faculties are fully aware of the advantages of superior education and culture to its possessor, and, other things being equal, they know it conduces to professional success. Accordingly, students whose age, means and circumstances justify such a plan are advised to study both for the A.B. and the professional degree.

SCIENTIFIC BOOKS.

Development and Evolution. By Professor JAMES MARK BALDWIN. New York, The Macmillan Co. Pp. 395. $2.60.

Although biologists all agree as to the general truth of the theory of descent, disagreement is still rife as to the *method* of descent of the species. Those who have been interested in these problems in recent years have been divided into two camps, agreeing as to the general facts but differing in their views as to the forces by which the evolution of animals has been brought about. One school has held a modified view of the Lamarckian theory, assuming that the directive force in evolution has been the environment which produces direct modifications in the individual, to be subsequently inherited. The second school has adopted an ultra-Darwinian position, denying that the modifications produced by the environment can be inherited, and insisting that acquired characters can play no part in evolution. According to this school, evolution has been due to the natural selection of congenital variations. Both of these schools have labored under serious disadvantages. The neo-Lamarckian school is quite unable to obtain any clear evidence that acquired characters are transmitted by heredity, and thus their fundamental datum is without demonstration. On the other hand, the neo-Darwinian school has labored under disadvantages of a different nature. No one questions the cogency of congenital variations or the importance of natural

selection as influencing evolution, but the difficulties connected with this special theory of a more general character have been so serious as to have convinced many modern naturalists that natural selection of congenital characters is insufficient to account for the facts of nature.

A few years ago there was suggested to biologists a new conception of the method of evolution, a method which was believed by its advocates to remove many or most of the difficulties of the two schools hitherto recognized, and to give an explanation of the process of evolution more intelligible and not open to the lines of criticism which were raised against the two other views. This new suggestion was independently conceived by three different naturalists, Professor Baldwin, of Princeton, Professor Osborn, of Columbia, and Lloyd Morgan, of England. The names that have been applied to the new theory are several. The one most commonly used has been *Organic selection,* a term which really expresses very little. Professor Baldwin himself has preferred *Othoplasy,* which term he now adopts in the volume which has recently appeared.

This new conception of evolution in a way offers a compromise between the views of the natural selectionist and the Lamarckian school, inasmuch as it does not involve the necessity of assuming the inheritance of acquired characters, but at the same time it assumes that acquired characters, or the environment in general, is the chief directive force in controlling the line of evolution. It, therefore, puts into the possession of evolutionists the uniform directive force of an environment, thus avoiding many of the difficulties of the natural selection theory, but does not involve the conception of the belief in the inheritance of acquired characters for which it seems to be impossible to obtain any proof or any good evidence.

The theory of organic selection or othoplasy can not be explained in a few words and no concise definition can be given of it. This theory points out the fact that acquired characters, though they may not be inherited, do produce profound modification in individuals. The development of acquired characters, therefore, adapts the individual to the new conditions of life and to any change in environment. Such adaptations enable the individual to meet changes in environment and to become adapted to new conditions of life. They, therefore, prevent the extermination of the individuals which might occur with modifications in environment. Even though such modifications be not transmitted by heredity, the second generation in the same environment would independently develop similar acquired characters and would itself become adapted to the environment. Thus the development of acquired characters would protect generation after generation from extermination, even though they were not transmitted by the force of heredity. Such a protection of the individual would shield from extermination members of the race that develop the acquired characters, and thus keep alive that portion of the race in which certain acquired characters develop. This shielding process would continue until, according to the suggestion of this theory, congenital variations might arise, amid the numerous indefinite variations of this character, which were in a line with the acquired characters. The acquired characters under these circumstances would have nothing to do with *producing* the congenital variations, but would simply preserve the life of the individuals until the proper congenital variations appear. The chief significance of this theory, then, is that it greatly prolongs the time over which the race might wait for the appearance of proper congenital variations.

The volume just published by Professor Baldwin contains a somewhat miscellaneous collection of chapters upon different phases of evolution. Certain phases of psychological evolution are found at the beginning, and at the close of the volume certain other suggestions of a more psychological character. The larger part of the work, and the part which to biologists in general will be the most suggestive, concerns the development of this theory of organic selection or othoplasy, as Baldwin prefers to call it. The subject has been developed with extreme care and the gen-

eral theory has been applied in numerous directions. The reading of this volume will give a very much more comprehensive conception of the significance of this new theory and the applications of various lines of evolution, than can be obtained from the reading of isolated papers on the subject which have hitherto appeared. Indeed, Professor Baldwin's discussion of this theory and its application in various lines is a real contribution to the general subject of evolution. No one who is interested in the modern doctrine of evolution and the method of the development of animals and plants can afford to miss reading this new work of Professor Baldwin's, for it throws a light upon many phases of the descent theory which are left in the dark by both the Darwinian and the Lamarckian schools. Although Professor Baldwin is not the sole originator of this conception, and has given due credit to the two who independently conceived it with him, he certainly has developed it more carefully than any other, and this new work of Baldwin's must be regarded as one of the positive contributions to the discussions of the evolution doctrine.

The other parts of the work, though interesting and suggestive, are, at least to the general biologist, less significant and instructive than this careful elaboration of the theory of othoplasy, but may be especially recommended to those interested in the psychological phases of evolution.

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SCIENTIFIC JOURNALS AND ARTICLES.

The Museums Journal of Great Britain contains a brief account of 'The Manchester Whitworth Institute,' a paper on 'The Descriptive Arrangement of Museum Collections,' by Frank C. Baker, dealing with that of the Chicago Academy of Sciences, and 'Notes upon the Haslemere Educational Museum,' by E. W. Swanton. This last is extremely interesting, describing a successful attempt to make a museum instructive at the minimum cost; the building covers 6,400 square feet and cost but £1,305. There are reprints of H. I. Smith's 'Methods of Collecting Anthropological Material' and of H. F. Osborn's paper on 'The Collecting and Preparing of Fossil Vertebrates.' Also there are the customary interesting notes.

The American Museum Journal has an account of 'Entomological Work in the Black Mountains of North Carolina' by Wm. Beutenmüller and an illustrated article on 'Collecting Flamingoes and their Nests in the Bahama Islands' by Frank M. Chapman, which gives a very clear idea of the breeding grounds of a flamingo colony. The lecture announcements are made. *The Guide Leaflet Supplement* is devoted to 'The Sequoia, a Historical Review of Biological Science' by George H. Sherwood. It is primarily a brief account of the specimen of Sequoia acquired by the museum and secondarily a review of the progress of science during the life of the tree, which was 1341 years.

The Plant World for September commemorates its fifth anniversary, by issuing a number comprising many more pages and plates than usual. It contains 'Extracts from the Note Book of a Naturalist on the Island of Guam,' by W. E. Safford; 'A Deciduous Tropical Tree,' by O. F. Cook; 'Our Vanishing Wild Flowers,' by L. H. Pammel; 'The Etymology of Columbine,' by E. J. Hill; and the second paper on 'The Origin of Plant Names,' by Grace S. Niles. There are the customary notes, reviews and briefer articles.

SOCIETIES AND ACADEMIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-second annual meeting of the American Association for the Advancement of Science, and the first of the 'Convocation Week' meetings, will be held in Washington, D. C., December 27, 1902, to January 3, 1903.

A meeting of the executive committee of the council (consisting of the general secretary, secretary of the council, the permanent secretary, and the secretaries of all the sections), will be held in the council room of the Cosmos Club at noon on Saturday, December 27.

The opening session of the Association will be held at 10 o'clock A.M., on Monday, January 3, in Lafayette Theater. Most of the sections and of the affiliated societies will meet in the buildings of the Columbian University.

Railroad Rates.—A rate of one fare and one third has been secured for all persons attending the meeting, and tickets may be purchased from December 15 to January 3, and will be accepted until January 15.

For all matters relating to the local arrangements, transportation, and hotel and boarding-house accommodations, address the local secretary, Dr. Marcus Benjamin, Columbian University, 1420 H Street, Washington, D. C., or consult the preliminary announcement which will shortly be mailed to all members. The hotel headquarters of the Association will be the Arlington Hotel ($4 per day, American plan). Other hotels, including the Ebbitt House ($2 per day, American plan), will be chosen as headquarters for several of the affiliated societies.

For information relating to the presentation of papers, members should address the secretaries of the respective sections. Titles and abstracts of papers should be sent to the permanent secretary.

Nominations to membership and letters relating to the general business of the Association should be sent to the permanent secretary at the address given below.

Members paying their dues before December 20 will receive their tickets by mail at once, and will thus save time in registering on their arrival at Washington, provided they bring their tickets with them. Do not forget to bring your ticket if you have already paid your annual dues for 1903.

The register for the Washington meeting will be open at 10 o'clock A.M., on Friday, December 26, at the general office of the local and permanent secretaries, in the library on the first floor of the main building of Columbian University, corner of Fifteenth and H streets, northwest.

L. O. Howard,
Permanent Secretary.

Cosmos Club, Washington, D. C.

The rough program is as follows:

MONDAY, DECEMBER 29, 1902.

Meeting of the council at 9 A.M. in the assembly hall of the Cosmos Club.

First general session of the Association at 10 A.M. at the Lafayette Theater. The meeting will be called to order by the retiring president, Professor Asaph Hall, U.S.N., who will introduce the president elect, Doctor Ira Remsen. Addresses of welcome. Reply by President Remsen. Announcements by the general, permanent and local secretaries. Agreement on the hours of meeting. Adjournment of the general session, to be followed by the organization of the sections in their respective halls.

Addresses of the vice-presidents in the afternoon as follows:

At 2:30 P.M.

Vice-President Hough before the Section of Mathematics and Astronomy.

Vice-President Weber before the Section of Chemistry.

Vice-President Derby before the Section of Geology.

Vice-President Culin before the Section of Anthropology.

Vice-President Welch before the Section of Physiology and Experimental Medicine.

At 4:00 P.M.

Vice-President Franklin before the Section of Physics.

Vice-President Flather before the Section of Mechanical Science and Engineering.

Vice-President Nutting before the Section of Zoology.

Vice-President Campbell before the Section of Botany.

Vice-President Wright before the Section of Social and Economic Science.

At this hour also will be delivered the address of the President of the Astronomical and Astrophysical Society of America, Professor Simon Newcomb.

The annual address of the retiring president, Professor Asaph Hall, U.S.N., will be given at 8 P.M.

SUCCEEDING DAYS.

The council will meet daily at 9 A.M., in the lecture room on the west side of the first

floor of the main building of Columbian University. At 10 A.M. a short general session will be held daily in the main lecture room on the first floor of the main building of Columbian University. The sections will meet daily immediately after the adjournment of the general session and from that time until 1 o'clock, and then after an intermission of one hour for luncheon, from 2 to 5.

On Tuesday evening the address of the president of the American Chemical Society, Professor Ira Remsen, will be given at 7:30 P.M. On Tuesday evening the public lecture of the American Society of Naturalists will be given at 8 P.M.

On Tuesday evening the smokers of the American Society of Naturalists and its affiliated societies will be held, and on Tuesday evening the Botanical Society of Washington will receive visiting botanists.

On Wednesday evening the annual dinner of the American Society of Naturalists will be held, and the dinner will be followed by the annual address of the president, Professor J. McK. Cattell. It is expected that the annual dinners of the American Chemical Society and the American Society of Geologists will be held on this evening.

On Thursday evening a public lecture, complimentary to the citizens of Washington, will be given under the auspices of the A. A. A. S. and the National Geographic Society. The subject will be 'Volcanoes of the West Indies,' and the lecturers will probably be Professor I. C. Russell and Professor Angelo Heilprin.

Following this lecture there will be the regular meeting of general committee of the A. A. A. S., including the council and one member from each section, to elect officers and decide upon the time and place of the next meeting.

The permanent secretary has been notified that the following societies will meet in affiliation with the Association at the Washington meeting:

The American Anthropological Association.—This association will hold its first regular meeting in Washington during Convocation Week in affiliation with Section H of the A. A. A. S. President, W J McGee; secretary, George A. Dorsey, Field Columbian Museum, Chicago, Ill.

American Chemical Society.—This society will meet in Washington on December 29 and 30. The headquarters will be the Arlington Hotel. The retiring address of the president, Dr. Remsen, will be given on Tuesday evening at 7:30. President, Ira Remsen; secretary, Dr. A. C. Hale, 352A Hancock street, Brooklyn, N. Y.

American Folk-lore Society.—This society will meet in affiliation with Section H of the A. A. A. S. President, George A. Dorsey; vice-presidents, J. Walter Fewkes, James Mooney; secretary, W. W. Newell, Cambridge, Mass.

American Microscopical Society.—This society will probably hold a business meeting on December 29. President, E. A. Birge, Madison, Wis.; secretary, H. B. Ward, University of Nebraska, Lincoln, Nebr.

American Morphological Society.—This society will meet in Washington December 30 and 31. President, H. C. Bumpus; vice-president, G. H. Parker; secretary and treasurer, M. M. Metcalf, Woman's College, Baltimore, Md.

American Philosophical Association.—This association will meet in Washington during Convocation Week, December 30 and 31 and January 1. Secretary, H. N. Gardiner, Northampton, Mass.

American Physical Society.—This society will meet in Washington during Convocation Week, in affiliation with Section B of the A. A. A. S. President, Albert A. Michelson; secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.

American Physiological Society.—This society will meet in Washington, December 30 and 31. President, R. H. Chittenden; secretary, F. S. Lee, Columbia University, New York, N. Y.

American Psychological Association.—This association will meet in Washington December 30 and 31 and January 1. On Wednesday morning the association will hold a joint session with the American Philosophical Asso-

ciation. President, E. A. Sanford; secretary and treasurer, Livingston Farrand, Columbia University, New York, N. Y.

American Society of Naturalists.—This society will meet in Washington December 30 and 31. Members will register in the general registration room of the A. A. A. S. The public discussion will be held on the afternoon of December 31, and the public lecture will be held on Tuesday evening, December 30. President, J. McK. Cattell; vice-presidents, C. D. Walcott, L. O. Howard, D. P. Penhallow; secretary, R. G. Harrison, Johns Hopkins University, Baltimore, Md.

Association of American Anatomists.—This association will meet in Washington December 30 and 31. President, G. S. Huntington; vice-president, D. S. Lamb; secretary and treasurer, G. Carl Huber, University of Michigan, Ann Arbor, Mich.

Association of Economic Entomologists.—This association will meet in Washington December 26 and 27, the opening session will be held at 10 o'clock A.M. December 26. President, E. P. Felt; secretary, A. L. Quaintance, College Park, Md.

Astronomical and Astrophysical Society of America.—This society will meet in Washington during Convocation Week, in affiliation with Section A of the A. A. A. S. The address of the president, Professor Simon Newcomb, will be given at 4 P.M. on December 29. President, Simon Newcomb; secretary, George C. Comstock, University of Wisconsin, Madison, Wis.

Botanical Society of America.—This society will meet in Washington December 31 and January 1. President, B. T. Galloway; secretary, D. T. MacDougal, New York City.

Botanists of the Central and Western States.—This society will meet in Washington on December 30. Committee in charge of the meeting, John M. Coulter, University of Chicago; D. M. Mottier, University of Indiana, Bloomington, Ind.; Conway MacMillan, University of Minnesota, Minneapolis, Minn.

Geological Society of America.—This society will meet in Washington December 29, 30 and 31. Hotel headquarters will be the Ebbitt House. President, N. H. Winchell; vice-presidents, S. F. Emmons, J. C. Branner; secretary, H. L. Fairchild, University of Rochester, Rochester, N. Y.

The National Geographic Society.—This society will hold a meeting during Convocation Week, and is arranging to present a public lecture on the volcanoes of Martinique and St. Vincent on Thursday evening, January 2; also for one or more joint sessions with Section E of the A. A. A. S. for the presentation of scientific papers. President, A. Graham Bell; vice-president, W J McGee; secretary, A. J. Henry, U. S. Weather Bureau, Washington, D. C.

Naturalists of the Central States.—This association will meet in Washington December 30 and 31. Chairman, S. A. Forbes; secretary, C. B. Davenport, University of Chicago, Chicago, Ill.

Society of American Bacteriologists.—This society will meet in Washington January 1 to 3. President, H. W. Conn; vice-president, James Carroll; secretary, E. O. Jordan, University of Chicago, Chicago, Ill.; council, W. H. Welch, Theobald Smith, H. L. Russell, Chester, Pa.

Society for Plant Morphology and Physiology.—This society will meet in Washington during Convocation Week. President, V. M. Spalding; vice-president, B. D. Halsted; secretary and treasurer, W. F. Ganong, Smith College, Northampton, Mass.

Society for the Promotion of Agricultural Science.—This society will meet in Washington during Convocation Week. President, W. H. Jordan; secretary, F. M. Webster, Urbana, Ill.

Zoologists of the Central and Western States.—This association will meet in Washington during Convocation Week. President, C. B. Davenport, University of Chicago.

All members of affiliated societies, who are not members of the American Association for the Advancement of Science, are nevertheless requested to register at the registration desk of the Association, in the library on the first floor of the main building of Columbian University. The object of this

request is to endeavor to secure an approximate estimate of the number of scientific men in attendance at the Convocation Week meetings in Washington.

Officers of the local committee for the Washington meeting are:

President, Charles D. Walcott.
Vice-President, G. K. Gilbert.
Secretary, Marcus Benjamin.
Executive Committee, Marcus Benjamin, David T. Day, G. K. Gilbert, Gilbert H. Grosvenor, L. O. Howard, George M. Kober, W J McGee, C. E. Munroe, Chas. D. Walcott.

THE AMERICAN PHYSICAL SOCIETY.

THE autumn meeting of the American Physical Society was held at Columbia University on Saturday, October 25.

As has so often been the case in the past, the program was considerably more extended than was to be expected from the printed list of papers distributed before the meeting. Owing to some cause which it seems hard to explain, the titles of papers are frequently—I might almost say, *usually*—sent in too late for publication in the preliminary program. This fact cannot fail to have its effect, both on the discussion of the papers presented and on the attendance at the meeting. It is especially unfortunate for members residing at a distance, for whom attendance at the meeting means a considerable sacrifice of time.

The first paper presented was by A. W. Ewell on 'Accidental Rotatory Polarization.' Mr. Ewell had found in earlier work that certain jellies when subjected to twist are brought into a condition which enables them to rotate the plane of polarization of light traveling parallel with the axis of twist. The present paper described experiments along the same line. The direction of optical rotation was found to be opposite to the direction of twist. The amount of rotation is very largely influenced by stretching or compressing the piece of jelly in question in the direction of the axis of twist. Mr. Ewell finds also that the rigidity of jelly, like that of rubber, is greatly increased by elongation. Upon this fact he bases an explanation of the observed optical rotation. Since the strain is greater at points more distant from the axis, the rigidity varies according to the distance from the axis. A corresponding change in the optical rigidity would account for the results.

A paper by Carl Barus gave the results of some preliminary experiments on the 'Variation of Atmospheric Nucleation' and its dependence upon weather conditions. The method employed consisted in producing condensation by sudden expansion and in observing the size of the corona formed in the resulting mist. Previous investigations of Professor Barus have made it possible to compute the diameter of the individual droplets from the diameter of the corona. A measurement of the weight of all the mist formed in a given space thus makes it possible to compute the number of droplets and therefore the number of nuclei. Observations by means of this method were made several times a day for a period of some weeks. The effect of rain in clearing the atmosphere from nuclei was clearly shown. Professor Barus also pointed out other connections between the amount of nucleation and the weather conditions, but he regarded more extended observations as needed before definite conclusions could be reached.

A paper by George B. Pegram described some very interesting results obtained by the 'Electrolysis of Radioactive Substances.' In the case of thorium salts it was found that the anode acquired a relatively intense radioactivity, which, however, lasted for only a few hours. The kathode, in the electrolysis of thorium salts, showed scarcely any acquired activity. In the case of salts containing radium, however, both anode and kathode became very active after the current had passed for a few minutes. As a result of electrolysis the dissolved salts seemed rapidly to lose their power of imparting this radioactivity to the electrodes; after long-continued electrolysis with one pair of electrodes the effect produced upon new electrodes was very slight.

A note by Ernest Blaker described a substitute for a smoke film which has several advantages. A layer of a white powder could be readily formed upon glass by rubbing it

with moistened 'Bon Ami.' The resulting layer is easily and quickly prepared, without danger of breaking the glass, does not soil the hands, and gives as satisfactory a surface for recording tracings as does smoked glass. In fact the tracings are often sharper and better adapted for measurement than those made on a smoke film. The glass surface may be quickly and completely cleaned again by a slight rubbing with a dry cloth.

A paper by William Fox described a simple geometrical construction for tracing the path of a ray of light through a prism, for use in explaining the behavior of a prism to an elementary class.

It was decided to hold the annual meeting of the society at Washington, in connection with Section B of the American Association, during Convocation Week. The arrangements for the joint meeting were left in the hands of the officers of Section B and of the Society, and will be announced later.

Ernest Merritt,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

The 359th meeting was held on Saturday evening, November 1.

Frederick V. Coville spoke of the 'Dye Plants of the North Carolina Mountaineers,' illustrating his remarks with a series of herbarium specimens of the plants used, accompanied by examples of the colors obtained from them. He stated that the large use formerly made of these native dyes was partly due to the isolation of the mountaineers, partly to their poverty, and said that while there, as elsewhere, aniline dyes had come into use, an effort was being made to persuade the mountaineers to return to the once popular vegetable dyes. In regard to the extensive gathering of medicinal plants in the southern mountains the speaker said that he was told by Professor Mohr that this originated during the Civil War, when the South was obliged to rely for medicinal supplies largely on those that could be procured from native plants.

E. W. Nelson discussed the 'Evolution of Subspecies as Illustrated by Mexican Quails and Squirrels.' The series of quail exhibited showed a practically unbroken continuity of range of the genus *Colinus* from Florida around the gulf states to the Rio Grande, and thence south through eastern Mexico to Tabasco and across the Isthmus of Tehuantepec to and down the Pacific coast to the border of Guatemala. The series showed, in addition, that a considerable number of forms which have previously been considered strongly marked species are really but subspecies of the well-known bob-white (*Colinus virginianus*) of the United States.

A series of squirrels representing *Sciurus aureogaster* and its subspecies *S. a. frumentor* and *S. a. hypopyrrhus* was shown to illustrate the manner in which two complete reversals of color pattern occur in the intergrading series covering the geographic range of this species which inhabits the tropical gulf coast region of eastern Mexico.

H. J. Webber exhibited specimens of fruit resulting from crossing the edible orange with the hardy but valueless trifoliate orange. The result indicated the possibility of ultimately obtaining a variety of orange whose fruit should be of value, while the tree would grow much farther north than any existing variety.

F. A. Lucas.

TORREY BOTANICAL CLUB.

At the meeting of the Club on October 14 the scientific program consisted of informal reports of summer work and observations.

The Secretary spoke of his collections of Asters, also of *Euphrasia* and other alpine plants in the White Mountains. Discussion regarding Wettstein's monograph of *Euphrasia* followed. An interesting Euphrasid was collected by Dr. M. A. Howe in Newfoundland, a year ago.

Dr. MacDougal remarked upon the dissimilarity of the alpine conditions of the Rockies from those of the White Mountains. Tracts which in July in the rains of the White Mountains are covered merely with green would have been blazing with flowers if in the Rockies.

Dr. Underwood spoke of the recognition among farmers about Redding, Ct., of two

types of the sweet-flag, *Acorns Calamus* L., that with a white root being in favor, that with a red root being smaller and somewhat bitter, and with young leaves different in color. Dr. Underwood also mentioned his finding young plants of the date-palm coming up in railway rubble at South Norwalk, Ct., similarly observed on garbage-heaps about New York by Mr. Eugene Smith. He also spoke of the successful cultivation on a lawn at Danbury, Ct., of the native orchid, *Cypripodium reginæ,* where in four years a cluster of three or four plants has increased to forty.

Professor Lloyd reported observations near Northfield, Mass., on the protonema of *Schizostega,* the 'light-moss,' observing some differences from European characters. Testing a recent theory ascribing the spore-discharge of certain mosses to the impact of rain, Professor Lloyd secured interesting results with the capsules of *Diphyscium;* by tapping on them so as to indicate the fall of rain, the spores may be made to shoot out in a mass. On Cape Cod he observed moss capsules attached by a fungus. Beds of *Polytrichum commune* were also found killed by a fungus. Observations made by Professor Lloyd on the mode of distribution of *Lycopodium lucidulum* indicated a propelling power (in discharging gemmæ) of only about three feet on a level, not of six feet as required by a recent theory of distribution. Professor Lloyd also reported interesting observations on the fern *Onoclea sensibilis.* The name of 'sensitive fern' early used for this plant, has often provoked curious inquiry. The fern proves to show a certain regularity of movement; in case of cut plants when drying, their leaflets when touched will move toward each other with some rapidity. This is a wilting phenomenon, and the motion is a distinct bending from the midrib.

Dr. Tracy A. Hazen reported observations about St. Johnsbury, Vt., on the black maple, *Acer nigrum.* He maintained its specific distinctness from the sugar maple. Dr. Britton commented on its distinctness as seen in other parts of western New England and of western New York. Its leaves are darker beneath and are said to expand about two weeks later in spring. Its fruit is much larger and there seems a difference in the angle of divergence of the keys.

Mrs. Britton reported upon observations on an interesting *Vittaria* brought by Dr. Evans from Porto Rico, and upon a form of *Stachys* found by her on Hempstead Plains on Long Island. In a white cedar swamp there she observed the newly recognized fern *Dryopteris simulata* growing in great masses and abundantly distinct. Mrs. Britton also spoke of certain instances among the Musci of new habit assumed with new habitat, as in a *Leptodon,* usually on trees, latterly found in tufts on dry rocks; and in case of *Porotrichum Alleghaniense* as observed at Greon Lake, Jamesville, New York, an aquatic form surviving the desiccation of the rock surfaces and now assuming the habit of a *Climacium.*

Dr. Britton, whose summer was largely given to administrative work, secured some time for prosecution of his studies on the Cyperaceæ and the Crassulaceæ at Kew. Nearly half of the known species of North American Crassulaceæ are now growing in Washington or at the New York Botanical Garden, a necessary preliminary to proper descriptive work with these plants. The fleshy foliage and calyx require description from the life, not, as often hitherto, from herbarium specimens. Many of the numerous Mexican Crassulaceæ are very local, and known only from one or two localities.

Discussion followed upon the effects of the prolonged wet weather of the present season, Dr. Hazen remarking upon sedges in Vermont which are usually stiff, but this year were very long and decumbent.

EDWARD S. BURGESS,
Secretary.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

October 10.—The following original papers were presented:

Mr. D. W. Johnson, 'Basaltiform Coal from New Mexico.' Illustrated by specimens and diagrams.

Mr. H. W. Shimer, 'Amygdaloidal-like Cavities in Basic Dikes in Vermont.' Illustrated with specimens.

Professor J. F. Kemp exhibited and described a new model of Vesuvius.

October 17.—Professor J. F. Kemp reviewed an unpublished paper by Dr. W. P. Jenney on the reducing abilities of different chemical compounds.

Dr. Austin Rogers read a paper on the orientation of the crystals in fossilized echinoderms; and also reviewed papers on this subject by Cesaro and by Hessel.

October 24.—The following papers were reviewed: M. Michel-Levy, 'L'Eruption de la Montagne Pelée et les Volcans des Petites Antilles'; M. J. Thierry, 'La Catastrophe de la Martinique,' and M. F. de Montessus, 'Les Manifestations volcanique et sismiques dans le groupe des Antilles,' by Dr. A. A. Julien. O. T. Hill, 'A Study of Pelée,' by Mr. G. I. Finlay.

October 31.—The following papers were reviewed: A. C. Lawson, 'The Eparchæan Interval,' a criticism on the use of the term Algonkian (*Bull. Univ. of Cal.*), by Mr. C. W. Dixon. J. S. Flett, 'A Preliminary Examination of the Ash that fell on Barbados, after the Eruption of St. Vincent, with chemical analysis,' by Wm. Pollard and J. W. W. Spencer, 'The Geological and Physical Development of Dominica [*Quar. Jour. of Geolog. Soc.* (Lond.)], by Mr. W. Campbell.

H. W. Shimer,
Secretary.

THE LAS VEGAS SCIENCE CLUB.

At a meeting held October 22 several members of the club described the work they had done during the summer. Mr. E. L. Hewett had led a party of five westward across the Jemez Mountains, and had explored the desert in the region of the Chaco Mesa and beyond. The characteristic features of the country traversed were described, and numerous photographs taken by Mr. K. M. Chapman, a member of the party, were exhibited. These photographs included excellent portraits of the two surviving members of the tribe of Pecos Indians who inhabited the old Pecos pueblo some seventy years ago. One of these has since died, and the other is very old, so this tribe will very shortly be extinct. Mrs. Cockerell described her trip to the Truchas Peaks, in the Santa Fé Range, about 13,300 feet above sea level. She exhibited a number of alpine plants found above timber line on these peaks, several being new to the flora of New Mexico. There was also shown a very beautiful and apparently undescribed *Delphinium,* found in the forests on the peaks. Mr. T. D. A. Cockerell described his visit to Roswell, in the Pecos Valley, and exhibited some of the insects and mollusca obtained. Practically nothing was known before of the insect fauna of this region. Among the mollusca, the discovery of a species of *Unio* at Roswell was especially interesting, no species of Unionidæ having been found before in New Mexico. Some account was given of the deep lakes and gypsum bluffs near Roswell, and photographs of these taken by Professor J. D. Tinsley were exhibited.

T. D. A. C.

DISCUSSION AND CORRESPONDENCE.

THE BUREAU OF AMERICAN ETHNOLOGY.

To the Editor of Science: After the death of Major J. W. Powell, director of the Bureau of American Ethnology, the Secretary of the Smithsonian Institution, of which the bureau forms a part, has abolished the title of director, and appointed the head curator of the Anthropological Division of the U. S. National Museum 'chief' of the bureau. Through this action the independence of the two institutions involved has been brought to an end.

No severer blow could be dealt to the anthropological interests of the country than the subordination of the bureau to museum interests, and no means could be devised to hinder the development of the U. S. National Museum more effectively, than its subordination under the bureau. The methods and aims of the two institutions are fundamentally distinct. The Bureau of American Ethnology is charged with the investigation of the life and customs of the North American Indians. In its work it deals with their languages, institutions, religions, customs. So far as the culture of native tribes is expressed by tangible objects, it may be illustrated in museums, but the whole domain of human culture cannot be represented by museum specimens. For this reason no museum can undertake to de-

velop systematically the whole field of anthropology. A museum may, in special cases, undertake a full investigation of a special region which it may desire to represent exhaustively in its collections, but the primary objects of the museum forbid the systematic investigation of such subjects as mythology, primitive law, languages, etc. The history of anthropology in our country shows clearly the predominant influence of museum interests. The publications of the Peabody Museum, of the Field Columbian Museum, of the U. S. National Museum, of the American Museum of Natural History, of the Free Museum of Arts and Sciences in Philadelphia, except in so far as they deal with explanations of specially full collections, refer to the tangible side of human culture. Other researches find their places in museum publications only accidentally.

The rapid development of American anthropology is largely due to the fact that the Bureau of American Ethnology has been unhampered in its plans by museum interest. Therefore, it has been able to produce the linguistic map of North America, its valuable bibliographies, grammars, collections of texts and of myths. Therefore, much progress has been made in the study of the immaterial side of the culture of American tribes. The systematic preservation of languages, of myths, of religious beliefs, has been the prime work of the bureau, and of the bureau alone, and it has contributed more than any other agency towards a harmonious development of all sides of anthropological research.

The interests of anthropology make it imperative that the independence of the bureau from museum interests be jealously guarded, and that it be given the long-desired opportunity to expand its work over fields that are of national importance, and that no museum can touch. The physical and mental characteristics of Indian half-bloods, of negroes and mulattoes, and the effects of adaptation and amalgamation of the many European nationalities that settle in our country, are the proper field of work for the Bureau of American Ethnology. Owing to restrictions imposed by law, this work has never been undertaken, although it is of the greatest practical importance, and requires the kind of training that is found among the experts of the bureau. The bureau requires the strengthening of its resources and of its independence, not the weakening that will result from the combination of its administration with that of a division of the National Museum.

The effects of this combination may be not less disastrous to the National Museum. It is only a few years since the Secretary of the Smithsonian Institution found it necessary to establish the position of a head curator of the Division of Anthropology in the U. S. National Museum. At that time the work of the National Museum had come, in a way, to a standstill. The utter inadequacy of the building, the insufficient number of employees on the scientific staff, the constant demands upon their time for preparing special exhibits for the expositions of Chicago, Omaha, Atlanta, Buffalo, etc., made it impossible for the museum to make adequate use of its magnificent collections, and to contribute its share to the advancement of science and education. We hoped that the reorganization of the divisions of the museum might indicate the intention of the secretary to devote his energies to the development of the museum. In this we have been disappointed. The makeshifts of the last few years have not given us a museum worthy of a great nation. Is, then, the work for the head curator ended? Is not the full energy of an experienced museum man in that position needed just as much as or even more now than it was a few years ago? I cannot believe that the anthropological collections of the National Museum have so much contracted during the last few years that the need for an administrative head should be no longer felt.

The work of the director of the Bureau of Ethnology, and that of the head curator of the Anthropological Division of the Museum is so extended, that each requires the full time and energy of one man. The concentration of their administration can lead only to one of two results: either inadequate super-

vision of both, or nominal control only over the one or the other.

I doubt if the secretary is prepared to carry to its logical end the policy which he has adopted for anthropological work. If it is advantageous for anthropology to make the head curator of that division of the Museum director of the Anthropological Survey—for that is the function of the Bureau of American Ethnology—it will be no less advantageous to make the head curator of Geology director of the Geological Survey, and the head curator of Biology director of the Biological Survey. What would these great surveys be if they were simply appendages of the museum, while in reality it is the function of the museum to preserve the collections made by these agencies, to administer them for educational purposes, and to make them available for detailed study. The museum needs a policy of its own, and deals with problems distinct from those of the surveys. The correctness of this view is borne out by the fact that the recent development of the surveys has taken place independently of the Smithsonian Institution. The Geological Survey has grown to its present importance as a branch of the Department of the Interior, the Biological Survey as a branch of the Department of Agriculture. Their precedents suggest that if the Anthropological Survey were allowed to make itself useful to the practical needs of the government, and to develop in close contact with the needs of the times, rather than continue in a purely academic atmosphere, its usefulness might be greatly increased without taking away from the scientific value of its researches. The experience of the other surveys demonstrates conclusively that we need increased independence for the bureau, not restriction of its independence.

It is quite evident that the work of the National Museum must be carried on in cooperation with all the great surveys. It would seem to be one of the important duties of a director of the museum to establish and maintain such cooperation. Nevertheless, the work of the museum must always remain a unit, and distinct from the surveys that are important contributors to its growth.

Another aspect of the action of Secretary Langley appears to me not less objectionable than the considerations mentioned heretofore. Major Powell was the director of the bureau from the time of its establishment until his death. Since 1893 Dr. W J McGee has been ethnologist-in-charge under Major Powell. For nearly ten years he has been acting for Major Powell, and training to become his successor. According to all principles of good government, he should have been advanced to the position of director. The appointment of another man, no matter how good he may be, to the position, brings about discontinuity in the work of the bureau, which I consider dangerous, not alone to the best interests of anthropology, but to those of science in general. If the incumbent of the position that leads naturally to succession in the bureau had been inefficient, it might be expected that the secretary would have called attention to his inefficiency, and that he would have removed him long ago. By continuing up to the present time the organization of the bureau decided upon in 1893 the secretary has indicated that he agrees with the views of anthropologists who respect Dr. McGee for the ability, straightforwardness and success with which he has conducted the bureau under peculiarly difficult conditions. Therefore, the failure to appoint Dr. McGee to the succession in the directorship is most unfortunate. It introduces again a feeling of general instability in the scientific service of the government which we hoped had been entirely overcome by this time. Personal inclination of the appointing officer has once more outweighed the principles of continuity and stability, which are indispensable for the welfare of scientific institutions. I can only view with apprehension a condition of affairs that places the stability, yes the existence, of a great scientific bureau of the government entirely in the hands of a single man, who has the power to carry into

execution his personal views, uninfluenced by the opinions of the scientific world.

FRANZ BOAS.

COLUMBIA UNIVERSITY,
November 8, 1902.

A CORRECTION OF PROFESSOR OSBORN'S NOTE ENTITLED 'NEW VERTEBRATES OF THE MID-CRETACEOUS.'*

ON page 675 of this article in speaking of *Ornithomimus* Professor Osborn says: 'Mr. Hatcher states that he found Marsh's type of this genus, consisting of a foot and portion of a limb, on Cow Island, Missouri River, at a level which he estimates from 1,500 to 1,600 feet below the summit of the Judith River beds, and 500 to 600 feet below the level of Marsh's type of *Ceratops montanus.*' I certainly did not mean to convey the impression that I had found the type of *the genus,* but rather of the two species, *O. tenuis* and *O. grandis.* The type of the genus is *O. velox* and it was found in Colorado. The types of the other two species are from Montana and were found as Professor Osborn has stated, except that they were not found on Cow Island but near the foot of the bluffs on the north bank of the Missouri River, opposite Cow Island and just below the mouth of Cow Creek. Since this same error occurs also in Professor Osborn's 'Distinctive Characters of the Mid-Cretaceous Fauna' (No. 1, Part 2, Vol. 3, Contr. to Can. Pal.), I have thought it best to make the above correction.

Again, on page 673 of Professor Osborn's note in SCIENCE he says: '* * * the true Judith River beds certainly overlie the Ft. Pierre and are of more recent age.' I do not know upon what authority Professor Osborn makes this unqualified statement as to the deposits underlying the Judith River beds. It certainly does not agree with my own observations made during several weeks passed in collecting vertebrate fossils from these beds, nor with the published statements of Meek, Hayden and others, as will appear from the following: "They (the Judith River beds) appear, as near as could be ascertained, to occupy a local basin in a series of marine deposits, consisting of beds of sandstone and impure lignite, which we have regarded provisionally as of the age of No. 1 of our general section. Lower down the Missouri, near the mouth of Little Rocky Mountain Creek, this last-mentioned series of rocks upon which the fresh-water deposits repose at the mouth of the Judith is clearly seen to pass beneath No. 4 (the Pierre shales) of the general section."* During my work in this region in 1888 and again in 1892 I nowhere saw the Pierre underlying the true Judith River beds, although at that time I believed it belonged beneath these beds, not then being familiar with the work of Dawson, Tyrrell and other Canadian geologists. I remember, however, to have noticed some 300 or 400 feet of shales very similar to the Pierre overlying the Judith River beds along the old Ft. Benton and Cow Island trail between the Bear Paw Mountains and Cow Creek, and I have little doubt but that these are the representatives of the Pierre shales in this region.

The fact that Cretaceous Nos. 2 and 3 are entirely wanting in this region leads to the inference that they are represented by the lower members of the Judith River beds, and that the lower members of these beds are in reality older than the oldest of the Belly River series, a little farther north. Owing to the scarcity and fragmentary nature of vertebrate fossils in the Judith River beds they have not received the attention from vertebrate paleontologists that they deserve and from several points of view no more fruitful field awaits the collector than these deposits. They need to be thoroughly explored for vertebrate and invertebrate fossils, and their somewhat complicated stratigraphy must be carefully worked out in detail before we shall be able to fix with any degree of certainty either their upper or their lower limits. Beds of fresh-water, brackish and marine origin are here known to be interstratified with the upper and lower limits of deposits usually referred to the Judith River beds, and I should not be at all surprised that within the region lying along the eastern base of the Rocky Moun-

* SCIENCE, N. S., Vol. XVI., October 24, 1902, pp. 673–676.

* Meek and Hayden, *Proc. Phil. Acad. Sci.*, May, 1857, pp. 124–125.

tains and between the Saskatchewan River on the north and the Platte River on the south fresh-water representatives of the entire Upper Cretaceous series will yet be found. Both the terrestrial vertebrates and the fresh-water mollusca of the Belly River, Judith River and Laramie beds indicate that they and their ancestors found somewhere in this immediate region a congenial habitat where it was possible for them to continue their development without interruption. The Pierre shales in the Belly River region are remarkably thin as compared with the thickness to which they attain in the south, where the Belly River beds are wanting, thus indicating that in the former region the lower Pierre shales are replaced by the fresh-water deposits known as the Belly River beds.

Several years ago (*Am. Nat.*, February, 1896, p. 116) the present writer affirmed that the Judith River beds *were certainly older than the Ceratops beds of Converse County, Wyoming, and that the dinosaurs from the Judith River country belonged to smaller and less specialized forms than those from the latter locality.* It is gratifying to note that Professor Osborn has arrived at the same conclusion. In the article in the *American Naturalist* just cited I considered the Judith River beds as the equivalent of the 400 feet of barren sandstones lying between the base of the Ceratops beds and the marine Fox Hills sandstones in Converse County, Wyoming. I am at present of the opinion that they pertain to a still lower horizon.

J. B. Hatcher.

Carnegie Museum,
October 27, 1902.

SHORTER ARTICLES.

A CASE OF MIMICRY OUTMIMICKED? CONCERNING KALLIMA BUTTERFLIES IN MUSEUMS.

In a recent collection illustrating mimicry I noticed that the *Kallima* butterflies had been placed on twigs whose dried leaves were startlingly like the butterflies in their position of rest. There was no doubt that the butterflies were in exactly the right position for orthodox mimicry; the antennæ were carefully tucked out of sight, and the folded wings were in the plane of the adjacent leaves; and certain leaves of the spray had, it seemed, opportunely fallen off so as to allow the insects to seize the vacated places with unerring accuracy, each crouching at such an angle that the tail processes of the hind wings fitted near the scar on the stem where the leaf had been attached. The leaves, moreover, which had been chosen to imitate the tropical butterflies happened to belong to a *North American* tree, and it is even possible that they had been skilfully touched up to mimic, one, the usual type of *Kallima,* with distinct rib-like markings, another, the form which seems fungus-spotted.

As a work of art this preparation was certainly a success, and it taught interested visitors a forceful lesson in animal economy. But I have to confess that it gave me the feeling that both insects and preparateur had overdone their work. And that the preparation had an additional air of false pretenses about it for which the naturalist afield more even than the preparateur and the hapless butterflies, is to blame. For he is the one who allows the finishing details in such cases of mimicry to be assumed without critical foundation. In the present case, indeed, one may justly query whether *Kallima* mimics its surroundings as perfectly as the preparateur will have us believe. Wallace himself, who knew the creatures at first hand, does not figure them as accurately adjusted to their surroundings as are these mounted specimens. And even his account seems to need amplification, *e. g.*, as to the species of leaf mimicked and the more exact habits of the butterflies.* And beyond this I do not recall detailed field observation. Perhaps I should say that my faith in the possibilities of *Kallima* became somewhat weakened during a visit to the

* Thus he states in his 'Malay Archipelago' (p. 142) that 'the habit of the species is *always* (italics mine) to rest on a twig and among dead or dry leaves,' but later admits (Natural Section, p. 44) that only 'on one or two occasions the insect was detected reposing * * * .' He does not show furthermore what the leaf is that is so exactly mimicked, merely referring to general resemblance to 'the leaves of many tropical leaves and shrubs.'

Philippine Islands. In southern Negros, about a mile south of the little fishing village of Manjuyod, along the sides of the road to Bais, I noticed many of these butterflies; but to my surprise they were frequenting bushes whose leaves they in no way resembled. The leaves were bright green, magnolia-like, much larger than the butterflies, perfectly elliptical, glossy, turning bright orange yellow when dead, and falling to the ground. There were no brown leaves, pointed leaves, conspicuously veined or fungus-covered leaves in the neighborhood, say within a hundred rods. In this instance I could not help concluding that the dark-colored butterflies were conspicuous instead of inconspicuous, as they alighted on the *leaves* and not on the stems of the bright green bushes. And I observed the behavior of the butterflies with considerable interest at several favorable stations; their movements and flight reminded me of our Vanessas, more nearly perhaps of *Grapta;* they could be approached almost within reaching distance and could not be mistaken generically. I intended, however, to return that way and examine the shrub and collect the insects and if possible their eggs and larvæ, but by an unfortunate accident I was obliged to cut short my stay and thus miss my chance. From the behavior of the butterflies, my impression is that they were breeding then and there, and on one leaf of the shrub I noticed a patch of eggs which might well have belonged to *Kallima.* At that time my faith was strong and I was inclined to believe that the butterflies were migrating or had even for the moment become careless as to their surroundings, and I felt that had I looked further afield I might have found the leaves which were so admirably mimicked.

For the rest the question is whether it is just for the naturalist, the preparateur and *Kallima* to compound such museum preparations as we have above described, on present evidence. I for one would be glad to learn of additional observations, for, like many others, I am not able to repress a suspicion that in *some* cases (who knows in how many, even perhaps in the case of these classic butterflies?) our idea of the mimicry may be preconceived, rather than truthful. The fact that a butterfly looks strikingly like a given dead leaf is no adequate proof that it was evolved in mimicry—it must be proven a mimic in all details. Otherwise it should be kept in limbo with those creatures which to our eyes and to our eyes only suggest natural objects—such creatures as moths with skulls pictured on their backs and Taira-headed crabs.*

BASHFORD DEAN.

'ROOT-PRESSURE' IN BEGONIA (FLETCHER'S SEEDLING).

ON July 15, a vigorous *Begonia* was selected from the greenhouse plants at the Harvard botanic gardens with a view to illustrate, to the students in botany at the summer school, some of the phenomena in connection with the so-called 'root-pressure.'

The stem of the plant was cut off about three inches above the surface of the soil in the flower-pot, and a firm rubber tube was fixed to the stump and connected with a glass tube held in a vertical position. A small amount of water—about one cubic centimeter—was poured in upon the cut end of the stem. The glass tube first attached was about two and a half feet long and the diameter of the bore was three millimeters. In twenty-four hours after arranging the experiment the sap had ascended to a height of two feet one inch, and in twenty-four hours later the tube was overflowing. Another tube was then added, the connection being made with a short piece of rubber tubing.

* In the twelfth century the famous sea fight off Dannoura saw the destruction of the dominant Taira family of Japan; it is recorded that upward of twenty thousand of this clan and their adherents lost their lives; and their bodies were washed up on the neighboring beaches in wind rows. Each Buddhistic soul, however, was said to have passed into the crab, *Dorippe*, which to this day retains its imprint. The carapace bears in bas-relief a striking likeness to the face of an Oriental, and the fishermen, in 'proof' of the accuracy of the legend, point out further details in resemblance—the eyes and mouth are open, and the face is swollen, after the fashion of the drowned!

The sap rose steadily, and when the tube added was filled, another was attached in the same way, until the upper tube reached the ceiling of the room. In making attachments a break occurred at the first joint above the stem, resulting in a loss of sap down to that point. The break was repaired and the experiment continued. Another accident happened at the same joint when the sap was over six feet high, resulting in a further and more considerable loss of sap. On August 14 the sap stood nine feet ten inches high in the tube. The total amount of sap that passed through the plant into the tube was 165 c.c., taking into consideration the loss by accident, and estimating the whole tube as of uniform bore, making no allowance for the greater volume where the sap was in contact with the rubber tube. The flower-pot stood in a plate in which a little water was poured every other day. The soil in the pot was watered from time to time, so as to keep it moist, and in a condition under which the plant would most likely thrive best. It will be noticed that the plant was under these abnormal conditions thirty days, and that, so far as could be learned from the appearance on August 14, and from the fact that the sap in the tube kept rising, the plant seemed to be alive. The force that caused the ascent of sap in the tube, and that which kept the column at the height mentioned, is certainly due to some property of the living *Begonia*. A plant under similar conditions, but first killed by heating, will produce no ascent of liquid, and since it can not be produced by soil and the tubing, we must look for the causes in the living plant. This ascent is probably due to what we call 'root-pressure,' and, as root-pressure is accounted for by an osmotic pressure resulting from the sap in the cells of the roots and root hairs, the conclusion is that the sap in the tube was forced nine feet ten inches high and kept there by an osmotic pressure of the cell sap. But it can scarcely be wholly due to osmotic pressure, because the sap in the glass tube proved to be a solution too dilute, and this in the tube must be more concentrated osmotically than that in the roots, in order that sap may be transferred from cell up through the plant. When we say too dilute we are estimating concentration and pressure from van't Hoff's law relating to substances in solution.

This ascent of sap in the *Begonia*—a plant about fourteen inches high—is an illustration, to some extent, of the tension to which the cells of plants are subjected in the normal condition of life. If there be a pressure in the plant equal to a column of water nine and three fourths feet high, and the plant be only fourteen inches high, the cell tension in the top leaves would be a pressure of eight feet at least.

Reasoning from this condition of affairs in this plant, it may be that—if the turgor in the leaves of tall trees is as great as that in the *Begonia*—the forces have to be sufficient to sustain a column of water eight feet higher than the top leaves of the plant. Moreover, in view of experiments of Morse and Frazer,* plant sap may exert an osmotic pressure far in excess of that which it would have, according to van't Hoff's law: 'The osmotic pressure of a sugar solution has the same value as the pressure that the sugar would exercise if it were contained as a gas in the same volume as is occupied by the solution.' Morse and Frazer have shown that a normal solution of cane sugar exerts a pressure of 31.5 atmospheres at least. They estimate that the pressure could not be less than 33 atmospheres, their cell having been shattered at a pressure of 31.5.

Now, according to van't Hoff's law, a normal solution of cane sugar should exert a pressure of not more than 23 atmospheres, unless sugar dissociates; but, as far as is known, sugar does not dissociate in aqueous solutions. The results of Morse and Frazer present to the botanist some very striking suggestions, and it may throw some light upon the ascent of the *Begonia* sap in the glass tube in our experiment.

That there is some force beyond that indicated in van't Hoff's law seems evident, from Morse and Frazer's experiment. Osmotic pressure, according to this law, does not ac-

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count for 33 atmospheres pressure in a normal solution of cane sugar, nor does it, in our opinion, account for the ascent of sap in the tube attached to the *Begonia*.

Van't Hoff's law is based upon Pfeffer's researches, and Pfeffer states: 'The same pressure (22.4 atmospheres) must be exerted by a solution of 342 grams of cane sugar in one liter of water;' and further: 'Hence it follows that osmotic values may be calculated directly with perfect safety and accuracy.' It is certain that, if Morse and Frazer's results are reliable, Pfeffer's osmotic conclusions and van't Hoff's theory collapse, and the true osmotic pressures are not yet known.

The experiment with the *Begonia* plant, in the light of the results of Morse and Frazer, leads one to suppose that the actual osmotic pressure—or that force producing pressure—is far in excess of that indicated in van't Hoff's law.

JAMES B. DANDENO.
AGRICULTURAL COLLEGE, MICH.
October 30, 1902.

THE GRAND GULF FORMATION.

THE classification of the formations of the gulf coastal plain more recent than the Vicksburg Limestone, has long presented difficulties to the geologist.

One of the most important of these formations, as regards at least extent of surface outcrop, is the Grand Gulf, classed as Eocene by Dr. Hilgard and by Mr. Kennedy of the Texas Survey; as Oligocene by Mr. Gilbert Harris and Miss Maury; as Miocene by the Alabama Geological Survey ('Coastal Plain Report'). Dr. Wm. H. Hall, who has published much concerning the formation, has at different times referred it to the Eocene, the Oligocene and the Miocene.

These classifications, in the absence of characteristic fossils, have been based largely, if not solely, on the stratigraphical position of the beds, heretofore supposed to be unconformably overlying, and chronologically next succeeding the Vicksburg Limestone, and many sections have been published showing these beds and the Vicksburg Limestone in immediate contact.

Our observations made during the past summer, of the surface distribution of the Grand Gulf beds in Washington, Mobile, Baldwin, Escambia and Covington Counties; an interpretation, in the light of these observations, of some sections recorded in the 'Coastal Plain Report'; and our identifications of some shells brought up from borings recently made at the Bascom Well near Mobile, and at Alabama Port in the southeastern part of Mobile County will, it is believed, help to clear up some of the obscurities which have heretofore beclouded the classification of the coastal plain formations of the Gulf States.

1. From Healing Springs in Washington County southward to within three miles of the coast near Bayou La Batre in Mobile County, the surface formations are Lafayette sands and pebbles, resting *directly* on Grand Gulf mottled clays, overlying cross-bedded sands of the same formation. Along bay, river and gulf margins the more recent Port Hudson strata occur.

2. In Baldwin County, from its northern border down to the Gulf coast, a distance of seventy miles or more, the surface is in like manner formed by the Grand Gulf beds with overlying mantle of Lafayette.

Southward of the line of the L. & N. railroad, this county is a high plateau, 200 feet above tide near the line of the railroad, declining to 75 feet or more on Perdido Bay; with surface, away from the immediate vicinity of the streams and bays, almost perfectly flat, but for the slight sinks or depressions of the hundreds of ponds and savannas which characterize the Grand Gulf in the lower parts of the two coast counties of Alabama, and contiguous parts of Florida. The original plain in Baldwin has been far less modified by erosion than that of Mobile.

The high land in places extends to the water's edge, terminating in high bluffs along Mobile Bay from Daphne down below Montrose, and along Perdido Bay from above Suarez's landing down to Soldier Creek.

These bluffs, 75 feet and upwards sheer height, show in most characteristic exposures the thin capping of Lafayette resting on the clays and cross-beds sands of the Grand Gulf.

3. While in most cases the Grand Gulf along

the northern border of its outcrop overlies the Vicksburg Limestone, in Covington County we see it lapping up over both upper and lower Claiborne.

4. At Chattahoochee landing on the Georgia side of the river there is a well-known exposure of Tertiary (Chattahoochee) fossiliferous beds, overlain by the cross-bedded sands and purplish clays of the Grand Gulf, which in turn are capped by the sands, etc., of the Lafayette.

5. In Escambia County, at Coal Bluff and at the mouth of Silas Creek on Escambia River, and at Lovelace's old mill near Roberts, the Grand Gulf beds are seen overlying strata holding casts of *Cardium Chipolanum* and other fossils, which led Dr. Dall to correlate them with the lower Miocene (more recently Oligocene). In our 'Coastal Plain Report,' we considered the fossiliferous beds to be a part of the Grand Gulf strata, and the lower Miocene age of the latter was thus thought to be definitely fixed. Our recent observations, however, of the unconformity existing between the Grand Gulf and the fossiliferous Tertiary beds in these localities, and of the occurrence of the former as surface beds, southward to the very shores of the Gulf, compel us to change our views and to assign to the Grand Gulf a place in the stratigraphical column not only far above the Tertiaries exposed on the Chattahoochee and Escambia rivers, but also above any unquestioned Tertiary existing in Alabama.

6. The evidence of the comparatively recent age of the Grand Gulf formation thus furnished by its surface distribution, is confirmed and extended by the materials brought up from three deep wells bored in Mobile County, viz., one at the brewery in the city, one about three miles southwest of the city, (the Bascom Well) and one at Alabama Port on Mon Louis Island near the southeastern end of the county.

The boring at Alabama Port had last summer gone down to a depth of 900 feet, and from near the bottom shells were brought up which have been identified, viz., *Rangia Johnsoni*, Dall; *Mactra lateralis*, Say; *Hydrobia Mobiliana*, Dall, and about ten other species, mostly new and brackish water forms. Above the shell horizon the boring penetrated mainly sands and clays and sandstones, the latter reported as being altogether 400 feet thick and in places exceedingly hard. These beds can not well be anything else than Grand Gulf, and the shells come from below them and represent the Pascagoula horizon of Johnson, regarded by Dr. Dall as of Chesapeake Miocene age. The boring at the brewery in Mobile brought up the same shells from a depth of 735 feet, and the boring at Biloxi, Miss., reached the same Pascagoula formation at the depth of 700 feet.

The boring at the Bascom Well near Mobile pierced the same formation and furnished the same fossils, but this boring went deeper, and between the depths of 1,500 and 1,556 feet brought up shells which are identical with forms occurring at Oak Grove in Florida, now considered as Oligocene by Dr. Dall.

List of Shells from Bascom Well, Mobile, Ala. (from 1,500 to 1,553 feet depth).

Mitra cf. *Hanleyi*, Dohrn.
Litiopa sp. fragments (probably young).
Nassa sp. fragments (probably young).
Tornatina incisula, Dall.
Terebra indenta, Con.
Neverita duplicata, Say.
Bittium priscum, Dall.
Oliva sp. young.
Turritella terebriformis, Dall (Alum Bluff horizon).
Micromeris sp. very young.
Leda acuta (?) Con. young.
Leda sp.?
Nucula sinaria, Dall.
Phacoides piluliformis, Dall.
Hemicardium apatelicum, Dall.
Corbula Whitfieldi? Dall. (young).
Orbitolites duplex, Carp.
Orbiculina adunca, F. & M.
Lucina Pennsylvanica, Linn.
Lucina dentata, Lam.
Venus Burnsii, Dall.

To sum up the evidence thus adduced: The Grand Gulf is not Eocene, it is not Oligocene, it is not Miocene, since it overlies in turn each of these formations. By its position it must, therefore, be either Pliocene or more recent,

and we are inclined to the belief that it is Post-Tertiary because, among other things, it carries fresh-water fossils. We are also inclined to the belief that the Pascagoula formation will eventually turn out to be Pliocene. If we are correct in our belief that the Grand Gulf is of Post-Tertiary age, the Lafayette formation must be advanced higher in the scale than the position now generally assigned to it.

EUGENE A. SMITH,
TRUMAN H. ALDRICH.

THE JOHN FRITZ MEDAL.

A 'JOHN FRITZ MEDAL,' established by personal and professional friends in celebration of the eightieth birthday, August 21, 1902, of the 'Nestor of the American Iron and Steel Industry,' and in honor of that venerable pioneer, was formally announced at a banquet tendered Mr. Fritz by its founders, on October 31, at the Waldorf-Astoria. The medal is to be annually awarded to perpetuate the memory of his achievements and for notable scientific or industrial discoveries, inventions or other great work performed by its recipients.

The new honor is to be conferred on men nominated, not less than one year in advance of the date of award, by a board consisting of sixteen men, chosen in equal numbers from each of the four national engineering societies by their governing bodies. The medal is of gold, its design by Mr. Brenner, the obverse presenting a good portrait of Mr. Fritz, the reverse bearing the symbolic device, a messenger, her right hand sustaining a shield on which is to appear the name of the recipient of the medal, the left hand carrying laurels and a palm branch. In the distance appears the torch of learning and a scroll on which is inscribed a statement of the purpose of the medal. The endowment of this foundation is made by contributions from several hundred members of the engineering profession and amounts to about $6,000. Its recipient will also be given a certificate stating the origin and purpose of the medal and the specific achievement for which the individual award is made. The plan adopted is similar to that on which the award of the famous Bessemer Medal of the Iron and Steel Institution of Great Britain is made by its founders and which medal has been several times awarded to distinguished Americans, Mr. Fritz among others. In the present case, the specific provision is made that 'there shall be no restriction on account of nationality or sex.'

John Fritz, in whose honor this new and important scientific distinction is established, was born at Londonderry, Pennsylvania, August 21, 1822, the son of a reputable farmer. At the age of sixteen he entered a country machine shop at Parkersburg, later a similar establishment at Norristown, to learn the business. He next took up the construction of rolling mills and, meantime, made himself familiar with every detail of the iron and steel business from that of reducing the ores in the blast furnace to the puddling of iron and the final work of the rolling mill. He became, in due time, an authority and acknowledged expert in his art and erected some of the most important establishments of the time, including the Cambria Iron Works, and, finally the now enormous plant of the Bethlehem Iron and Steel Works, of which latter he was manager and with which he remained for a generation. He introduced some of the most important of modern methods and apparatus and was one of the earliest and most successful among the pioneers in the use of the Bessemer process in the United States.

Since his retirement from the superintendency of the mammoth establishment which grew up under his hand, Mr. Fritz has been engaged in many enterprises as consulting expert and in some public works. He is a member of the principal associations, professional and scientific, in his field, both at home and abroad. He still enjoys good health and is strong and active and as much interested in life and good works as ever.

The foundation of this medal is hoped to prove a valuable incentive and aid to applied science, evidencing appreciation of good work and great deeds on the part of able men, as well as constituting a permanent and worthy monument to the man whose own admirable life and great work is thus given an enduring and fitting memorial.

R. H. THURSTON.

ANOTHER HODGKINS GOLD MEDAL AWARDED.

In March last, Secretary Langley, of the Smithsonian Institution, appointed a committee to consider whether any discovery had been made since the award of the first Hodgkins Gold Medal in 1899, under the general terms of the gift, 'the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man,' which would render it proper that such a medal should be again awarded. This committee consisted of the following distinguished men of science: Mr. Richard Rathbun, assistant secretary of the Smithsonian Institution, Chairman; Doctor A. Graham Bell, for electricity; Doctor Ira Remsen, for chemistry; Doctor Charles D. Walcott, for geology; Professor E. C. Pickering, for astronomy; Doctor Theodore N. Gill, for biology; Professor Cleveland Abbe, for meteorology; Mr. William H. Holmes, for anthropology, and Mr. S. W. Stratton, for physics.

Owing to the absence of Mr. Rathbun, Doctor Remsen served as chairman at a meeting of the committee held at the Smithsonian Institution in Washington, April 15, 1902. At this meeting the following resolution was unanimously adopted:

> That the committee recommend to the Secretary of the Smithsonian Institution that it is desirable that one of the Hodgkins gold medals be struck, and that it be awarded to J. J. Thomson, of Cambridge, England, for his investigations on the conductivity of gases, especially on the gases that compose the atmospheric air.

The finding of the committee being approved by the secretary, steps were at once taken to have the second Hodgkins gold medal struck under the personal supervision of its designer, Monsieur J. C. Chaplain, of Paris. The medal has recently been received by the Institution and has been despatched to Professor Thomson through the Department of State.

THE NATIONAL ACADEMY OF SCIENCES.

The Academy held its autumn meeting at the Johns Hopkins University, Baltimore, on November 11 and 12. The scientific program was as follows:

'A Possible Explanation of the Difficult Solubility of Certain Compounds Containing Fluorine and Hydroxyl,' S. L. Penfield.

'The Spectra of Stars of Secchi's Fourth Type,' George E. Hale.

'Biographical Memoir of Henry A. Rowland,' T. C. Mendenhall.

'The Embryology of *Salpa Cordiformis*,' W. K. Brooks.

'The Occurrence of Reef Corals near Beaufort, N. C.,' Caswell Grave (introduced by W. K. Brooks).

'The Trematode Parasites of the Oyster,' D. H. Tennent (introduced by W. K. Brooks).

'The Preparation of Cells for the Measurement of Osmotic Pressure,' H. N. Morse (introduced by Ira Remsen).

'A Substance with Remarkable Optical Properties, and Screens Transparent only to Ultra-Violet Light,' R. W. Wood (introduced by Ira Remsen).

'On Displacement Currents,' J. B. Whitehead (introduced by Ira Remsen).

'On the Spectrum of Hydrogen,' L. A. Parsons (introduced by Ira Remsen).

'A New System of Positions for Standard Stars, with Notes relative to its bearing upon Sidereal Astronomy,' Lewis Boss.

'Complete Skeleton and Restoration of the Cretaceous Fish *Portheus Molossus* Cope,' H. F. Osborn.

'A New Small Dinosaur from the Jurassic or Como Beds of Wyoming, apparently a Bird-catcher,' H. F. Osborn.

'New or little-known Elephants and Mastodons of North America,' H. F. Osborn.

'On Elevated Oceanic Islands in the Pacific,' A. Agassiz.

SCIENTIFIC NOTES AND NEWS.

We regret to announce the death of Professor Ogden Nicholas Rood which occurred from pleuropneumonia at his home in New York City on November 12. He was born in Danbury, Conn., in 1831, graduated from Princeton College in 1852, spent four years in study in Germany, from 1858 to 1863 was professor of chemistry and physics at Troy University and has for the past thirty-nine years been professor of physics in Columbia University. Professor Rood had been vice-president of the American Association for the Advancement of Science and was a member of the National Academy of Sciences. He was eminent for his researches in experimental

physics. We hope to publish subsequently an account of his life and work.

PROFESSOR J. J. THOMSON, the eminent physicist of Cambridge University, has been invited to be the first lecturer at Yale University on the Silliman foundation. This lectureship, endowed by the late Benjamin Silliman with $85,000, is somewhat similar to the Gifford lectures of the Scottish universities, providing for a course of lectures 'the general tendency of which may be such as will illustrate the presence and wisdom of God as manifested in the natural and moral world.' The lectures, however, must not be 'on topics appropriate to polemical or dogmatic theology.'

DR. W J MCGEE, ethnologist in charge, Bureau of American Ethnology, has been appointed by the President, through the Secretary of State, to represent the United States on the American International Archeological Commission, whose creation was recommended by the second International Conference of American States held in Mexico last winter.

PROFESSOR J. WILLARD GIBBS, of Yale University, has been elected a corresponding member of the Munich Academy of Science.

THE Academy of Natural Science of Philadelphia has, on the recommendation of its special committee, consisting of Theo. D. Rand, Amos P. Brown, R. A. F. Penrose, Jr., and Henry Fairfield Osborn, conferred the gold medal of the Hayden Memorial Geological Award for 1902 on Sir Archibald Geikie, LL.D., D.Sc., late director general of the Geological Survey of Great Britain and Ireland.

MR. J. S. DILLER, of the U. S. Geological Survey, who spent the field season in geological work in northern California, has returned to Washington.

PROFESSOR F. S. EARLE, assistant curator at the New York Botanical Garden, is in Jamaica in company with the Hon. Wm. Fawcett, director of the public gardens and plantations, for the purpose of making an investigation of the diseases of logwood, banana, cocoanut, ginger, pineapple and other economic plants of the island. Dr. M. A. Howe, assistant curator, is making an extensive survey of the algal flora of the Florida Keys.

THE Peary Arctic Club gave a dinner in honor of Commander Peary on November 13, the president of the club, Mr. Morris K. Jesup, presiding.

AT the banquet in honor of Drs. William W. Keen and Horatio C. Wood, at Philadelphia on November 6, Dr. William H. Welch, of Baltimore, proposed the toast 'Medicine,' to which Dr. Wood responded. Dr. William B. Coley, of New York City, gave the toast 'Surgery,' to which Dr. Keen made response. Dr. J. Chalmers Da Costa spoke to the toast 'The Pupil in Surgery,' and presented Dr. Keen with a loving cup. Dr. Hobart A. Hare replied to the toast 'The Pupil in Medicine,' and presented a loving cup to Dr. Wood.

DR. MAX WOLF, of the Observatory on Königstuhl, Heidelberg, has lengthened indefinitely the government appointment of Mr. R. S. Dugan, as his assistant. Mr. Dugan graduated at Amherst College in 1899, and after being Professor Todd's assistant, was in the Beirut Observatory for three years. He discovered a new planet (*KA*) at Heidelberg on October 25.

MR. GEORGE GRANT MACCURDY, lecturer in anthropology at Yale University, has been appointed curator of the anthropological collections in the University Museum.

PRESIDENT PRITCHETT, of the Massachusetts Institute of Technology, lectured at Buffalo before the Association of College Alumni on November 17, his subject being 'The Place of Industrial Training in the Education of a Modern Nation.'

THE eightieth birthday of Professor Friedrich von Esmarch, the eminent German surgeon, will be celebrated next year by the erection of a monument in his native town of Tönning.

DR. A. R. C. SELWYN, formerly director of the Geological Survey of Canada, died at Vancouver on October 19, aged seventy-eight years.

MR. WILLIAM GUNN, F.G.S., district geologist in the Geological Survey of Great Britian and Ireland, died on October 23, aged sixty-five years.

The death is also announced at the age of sixty-two years of Professor Eugen Hahn, director of the surgical department of the Berlin Municipal Hospital.

Sir Andrew Noble has given £150 and Dr. Ludwig Mond £200 to the Royal Institution for the fund for the promotion of experimental research at low temperatures.

A Reuter's telegram from Kingstown states that the *Scotia,* which is taking out the Scottish Antarctic Expedition, under the command of Lieutenant Bruce, arrived there on November 3, after a favorable passage. The ship is satisfactory in every way. The yachts *Gleniffer* and *Triton* were still in company with the *Scotia.*

The Engineers' Club of Philadelphia will celebrate its twenty-fifth anniversary by a banquet on December 6.

We learn from the *National Geographic Magazine* that on October 17 a number of scientific men and of those interested in geographic science met in Baltimore at the home of Dr. D. C. Gilman and organized the 'Geographical Society of Baltimore.' The aim of the society is the promotion and diffusion of geographical knowledge, more particularly of that which is of commercial importance to Baltimore. Vice-president W J McGee, LL.D., represented the National Geographic Society and extended its congratulations and well wishes to the new organization. Dr. Gilman, who is also one of the board of managers of the National Geographic Society, was chosen first president and the following officers and trustees were elected: First vice-president, Mr. Bernard N. Baker; second vice-president, Rev. Dr. John F. Goucher; third vice-president, Gen. Lawrason Riggs.

UNIVERSITY AND EDUCATIONAL NEWS.

The University of Pennsylvania has received $100,000 from Dr. E. W. and Clarence H. Clark for a chair in Assyriology, to which Dr. Hilprecht has been appointed.

Dr. and Mrs. C. A. Herter, of New York City, have given $25,000 to Johns Hopkins University for the foundation of a memorial lectureship in the medical department 'designed to promote a more intimate knowledge of the researches of foreign investigators in the realm of medical science.' This end is to be secured by inviting each year some eminent worker in physiology or pathology to deliver one or more lectures at the university on some subject with which he is especially identified. The lecturer will receive an honorarium, the annual income of the endowment fund. The committee to select the lecturer will consist of Drs. William H. Welch, William Osler and John J. Abel, and it is intended to continue this committee so as to represent pathology, physiological chemistry and clinical medicine. There is no bar to extending the proposed lectureship to leaders in medical research in America if deemed advisable. Dr. Herter was a graduate student at the university in 1887–88, pursuing a special course in Dr. Welch's laboratory.

The University of Tennessee will inaugurate at the beginning of January a department of education modeled on the Teachers College, Columbia University. The newly appointed professors include in the science and art of teaching, Professor P. P. Claxton, head professor of the department, formerly professor of pedagogy in the North Carolina Normal and Industrial Institute at Greensboro, now chief of the bureau of the Southern Education Board, and superintendent of the Summer School of the South; in philosophy and history of education, Professor Wycliffe Rose, formerly professor in the Peabody Normal School, University of Nashville; in educational psychology and ethics, Professor B. B. Breese, a graduate of Harvard University and doctor of philosophy of Columbia University.

Dr. H. Kobald, first observer in the astronomical observatory at Kiel, has been appointed to an associate professorship in the university.

Mr. W. H. R. Rivers, university lecturer in physiological and experimental psychology at Cambridge University, has been elected a fellow of St. John's College.